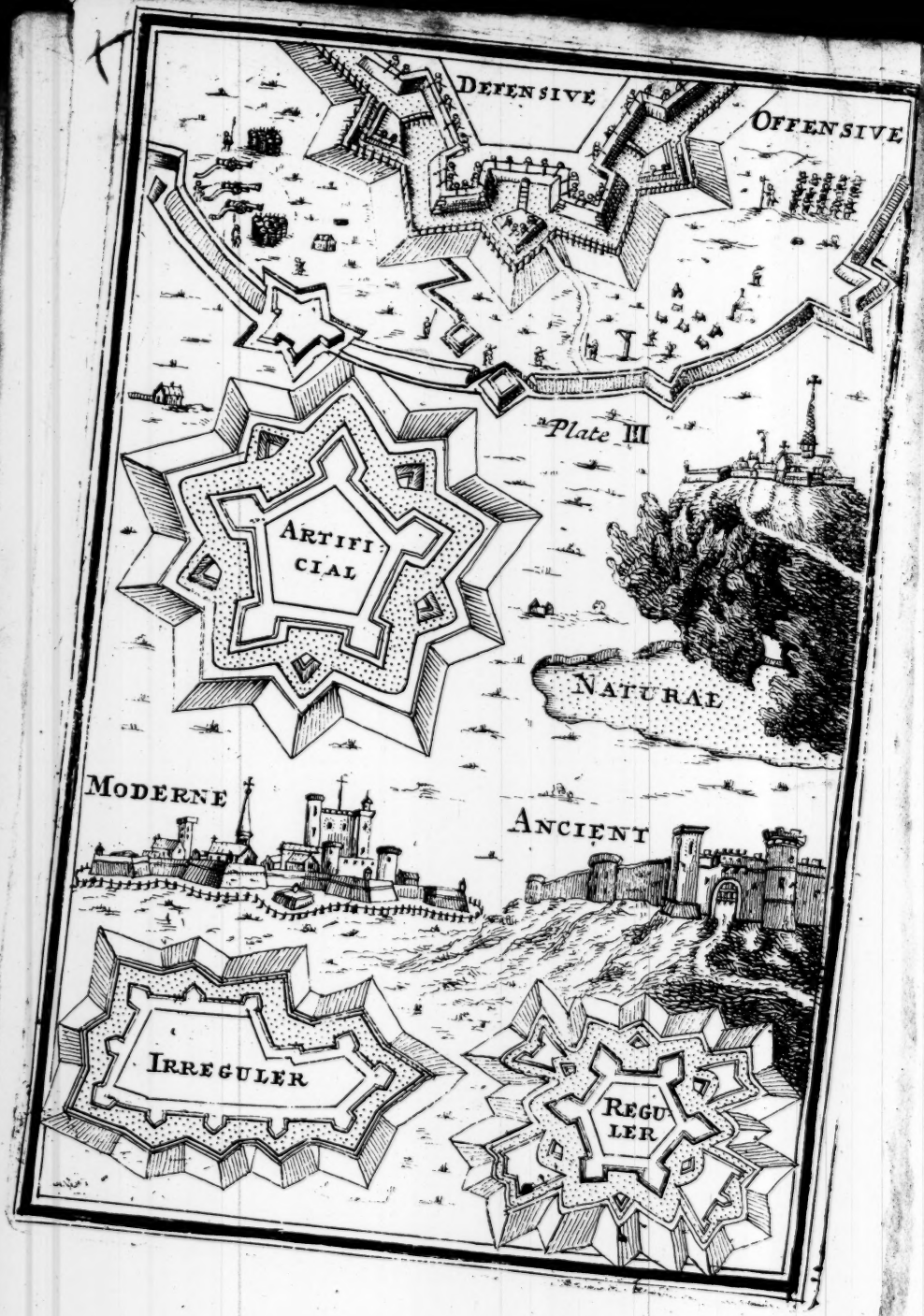
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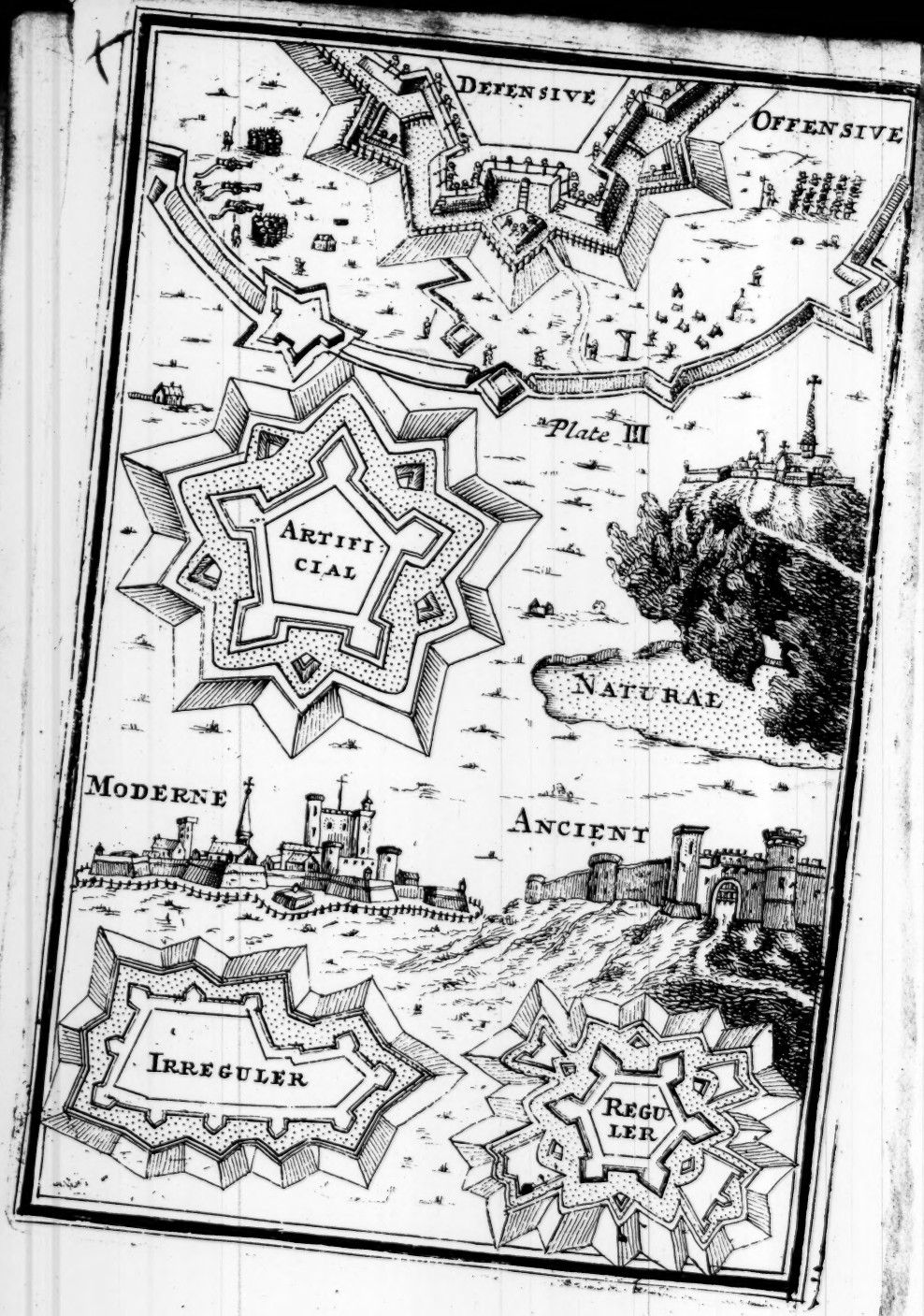
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Fortification
AND
Military Diſcipline
In Two Parts.

The Firſt ſhews the Principles and Practice of all manner of Fortifications, *Regular* or *Irregular*, as now uſed by the *Dutch*, *Engliſh*, *Italian*, *German*, and *French* Ingeniers.

The Dimenſions and Meaſures of the *Rampires*, *Parapets*, *Moats*, and all other Parts.

The Delineations of *Ravelins*, *Halfmoons*, *Tenails*, *Hornworks*, *Crownworks*, and *Cittadels*.

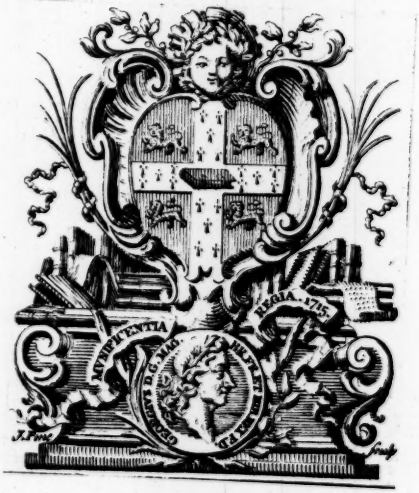
As alſo the making of *Batteries*, *Approaches*, *Trenches*, *Mines*, *Aſſaults*, &c.

The Second Part treats of the Rules for the Exerciſe of *Horſe* and *Foot*, with all ſorts of *Inſtructions* and other *Obſervations* belonging to the *Whole Art of War*, as now practiſed.

All Illuſtrated with 54 *Copper Plates.*

Improved and Deſigned by Capt. *J. Stevy.*

Publiſhed and Sold by *Robert Morden* at the *Atlas* near the *Royal Exchange* in *Cornhil*, *London*. 1688.



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THE Publiſher TO THE READER.

POſſible it is that ſome may ſlight and contemn this Treatiſe of Fortification and Military Diſcipline, becauſe it comes abroad without being Fortified and Defended by ſome Noble and Martial Patron. Let ſuch know, that it was ſo intended, but the Mine by Contra-Approaches was ſtrangely Countermined, ſo that the Unfortunate Author is forced to lie Intrenched in his Donjon, to the end he may not be condemned without hearing, or wounded without Defence. He very well knows, that Vulgar Opinion is very malicious and ſevere, like Soldiers in a Storm who kill and deſtroy without Witneſs or Judge. But if in any thing this may be uſeful to his Country, he will not much lament his Misfortune that compelled him to retire into his Bulwarks. If not, a Dedication can yield him no other ſatisfaction at this time, than a fair Sun-ſhine Day to a Seaman after Shipwrack;

Shipwrack; *and therefore the Undertaker is forced to Publiſh it*, *thus weak and open to the Aſſaults and Batteries of every confident and raſh Attacker*, *and ſhall only draw about it this ſmall but real* Traverſe *or* Parapet. *That it is the moſt* plain, eaſie, *and* compleat Treatiſe *ever extant in the* Engliſh Tongue. *'Tis true*, *there have been* ſome Books *of this* Art *in* Engliſh *before*, *but if I ſhould declare* at large *how* defective, *and how* little ſatisfactory *in ſeveral* Uſes *and* Directions, *as well as in the* Draughts, *and* lively Delineations *of every* Particular *here inſerted*, *I ſhould be too large for an* Epiſtle, *and ſome would be ready to tell me*,

Laudat venales, qui vult extrudere, merces.

If any Artiſt *or* Ingenier *ſhall carp at ſome* Rules *and* Directions *as too* plain *or* prolix, *give me leave to ſay*, *That it was* Calculated *for the* Meaneſt Underſtandings, *and not deſigned to* teach *the* more Learned *(though*, *'tis poſſible*, *they may find* ſomewhat more *than they knew before) but to learn others not* experienced *in the* Practice, *who by their* Induſtry, *and theſe* Directions, *may eaſily* attain *to be more ſerviceable to their* KING, *and thereby acquire* Reputation *and* Honour.

As for the Original Authors, viz. Tacquet, *Count* Pagan, Bocklern, Mallet, Blundel, *who*, *as they are well known*, *ſo they are highly eſteemed and approved in all Martial Countries*, *and therefore cannot be diſreſpected here.*

I need not therefore plead *any thing more either for the* Book, *or for the* Art: Empires, Kingdoms, Nations *and* People *cannot ſubſiſt*, *without* Practice *and*

and Experience *in it. And forasmuch as none are born* Soldiers, *and* Experience *comes not without* Industry, *I hope our* English Nation *will not* slight *and* neglect *it, and so frustrate the* Designs *and* Expectations *of a* MARTIAL SOVEREIGN.

Pardon me *therefore, if I affirm, That the more we* practise *this* Art, *the more* Courage *it will* inspire *into us, and the better* enable *us to serve our* KING *and* Country; *Which is the hearty Desire of*

Your most humble, & most obedient, Servant,

Robert Morden.

ERRATA.

PAge 11. line 21. for *b.* read *d.* p. 14. l. 22. r. *Prob.* 8. p. 18. l. 24. for *Fig. XIII.* r. *XIV.* p. 23. l. 2. for *Division* r. *Definition*, p. 24. for *Definition* r. *Division*, p. 25. l. 20. for *Definition* r. *Explanation*, p. 26. l. 5. for *C D.* r. *C G.* p. 37. l. 13. for *f. q.* r. 6. *d.* p. 38. l. 26. for 9. r. q, p. 43. l. 13. for *Plate* 7. r. 9. p. 53. for *B C.* r. *B D*, p. 44. l. 12. for 2. 8. r. 6. 7. p. 46 and 47. for 8. *d.* r. 7. *c.* p. 56. l. 29. for $7\frac{1}{2}$ r. $1\frac{1}{2}$ p. 58. for *B C.* r. *X.* 4.

A TREATISE OF Fortification, AND MILITARY DISCIPLINE, &c.

CHAP. I.

Of Geometrical Definitions.

WELL knowing that many Gentlemen and Soldiers, to whom I desire this Work may be as delightful as useful, are not very well skilled in *Geometry*, or of much knowledge in other parts of the *Mathematicks*; Therefore, to make the knowledge of *Fortification* the more plain and intelligible to them, I thought it convenient to lay down the first Rudiments and Practices introductive thereunto.

Geometry is the Art of measuring Bodies, in order to which end it considers three principal things, *viz.* Points, Lines, Superficies or Surface, which, in their proper Notion, do signifie the Outside, the Edge, and the Corners of the Body, and so are real parts of it; But, in a Geometrical Sense, they do not properly belong to a Body;

but are applied to it by Imagination: For if a Body be put into Water, though the Water touches it everywhere, yet we may fancy a Diviſion between it and the Water, which imaginary Diviſion is called a Surface. And thus every imaginary Diviſion of a Body begets a Surface between the Parts ſo divided, of a Surface begets a Line, of a Line begets a Point.

A Point is that which hath no parts either of Length or Breadth, and is the Bounds of a Line ordinarily expreſſed by a ſmall Prick.

A Line hath Length, but no Breadth, and is the Bounds of a Surface, and is either right or crooked.

A Superfiices or Surface hath length and breadth, but no Depth, and is the Bounds and Limits of a Body.

Of Figures.

A *Figure* is a plain Surface incloſed in one or more Lines, and is of two kinds, a Circle, and a Right lined Figure.

Of a Circle. Plate 1. Fig. 1.

A *Circle* is a round Figure, whoſe Superficies or *Area* is bounded with one Line called the Circumference or Periphery, and is always divided into 360 degrees or parts, the Point in the midſt whereof is called the *Centre c.* a Line paſſing through the Centre dividing the Circle into two equal parts, is called the *Diameter a. b.* half of that Line is called a *Semidiameter* or *Radius c. b.*

or

or an half of the Circle is called a *Semicircle*, *a.d.b.* and always containeth 180 degrees. The quarter or fourth part is called a *Quadrant*, as *a.d.* or *d.b.* and always containeth 90 degrees or parts. And any part of the Circumference cut off by a right Line, not touching the Centre, is called a Segment or *Arch*, as *f.e.g.* and is either greater or leſs than a Semicircle, and *f.g.* is the *Cord* or ſubtenſe of that Arch, *g.e.f.*

Of right lined Figures.

A right lined Figure is a plain Surface encloſed in three right Lines or more, and are either *Triangles*, or Triangulate.

A *Triangle* is a Figure bounded with three Lines, as *Fig.* 2. and are of ſix ſorts; three in reſpect of the Sides, and three in reſpect of the Angles. 1. *Equilateral*, which hath all Sides and Angles equal, as *a.b.c. Fig.* 2. 2dly, *Iſoſcele*, or equal legged, which hath only two Sides equal, as *b.c. Fig.* 3. 3dly, *Scalene*, which hath no Sides equal, as *b. c.d.* in *Fig.* 4. 4thly, A *Right angled Figure* which hath one right Angle, as *a.* in *Fig.* 5. 5thly, An *acute angled Figure*, which hath all its Angles acute, as *o. p. q.* in *Fig.* 2. or *Fig.* 3. which are called *Oxygoniums.* 6thly, An *Obtuſe angled*, which hath one obtuſe Angle, as at *a.* in *Fig.* 4. which is called an *Amblygonium.*

An *Angle* is the corner or meeting of two Lines croſſing or interſecting one another in one Point, as at *a.* and is either Right or Oblique, *Fig.* 6. which Angle (*a*) is greater or leſs, ac-

cording as the Lines *a. b. a c.* lean nearer, or ſtand further off one from another.

A *Right Angle* is made by two right Lines touching or cutting one another perpendicularly or ſquarely, that is, when the two Angles on each ſide are equal to each other, and are always 90 degrees, as *Fig. 7.*

An *Oblique Angle* is either greater or leſſer than a right Angle, and is either obtuſe if greater, or acute if leſſer.

Here Note, That no *Triangle* can have more right or obtuſe Angles than one, for no *Triangle* upon a plain Surface can conſiſt of three greater *Angles* than ſuch as are altogether equal to a Semicircle, or two right Angles, *viz.* 180 degrees; ſo that a right Angle is always a quarter of a Circle, or 90 degrees. And the remainder of any acute Angle to 90 degrees, or any obtuſe Angle to 180 degrees is called the Complement, as if 50, then 40 is the Remainder or Complement of that acute Angle to 90; ſo if 110 for an obtuſe Angle, then 70 is the Complement to 180. For if upon the Point *c. Fig.* 8. you move a Line ſuppoſe from *b* to *f.* then it will make an acute Angle *b. c. f.* the Complement to 90. but if you move it forwards towards *d*, it is then a right Angle, or 90 degrees; *b. c. d.* for *d. c.* 90 degrees, falls right on *a. b* and makes *b. d.* equal to *d. a.* but if you move the Line further towards *e.* then is the Angle *c. b.* obtuſe, the Complement to 180 degrees, or a Semicircle. Hence it plainly appears, that let there be never ſo many Angles ſet upon one Point, as at *c.* all will be but two right Angles, *Fig.* 9. ſo alſo if two ſtrait Lines croſs one another, they

make.

make four Angles all equal to 360 degrees, or the whole Circle, *Fig.* 10. Note alſo, that all *Triangles* are expreſſed by three Letters, and the Angular Point by the middle Letter.

Quadrangular Figures are ſuch as have four Angles, and as many Sides, and theſe are either *Parallelograms* or *Trapezias*.

A *Parallelogram* is a four-ſided Figure bounded with parallel Lines, that is, ſuch Lines as if they were infinitely extended they would never meet, but are everywhere equally diſtant one from the other.

Rectangular Parallelograms are ſuch as have four right Angles, *viz.* the Square, and the oblong Square, as *Fig.* 11. The Square or *Tetragon* hath 4 right Angles, and 4 equal Sides. The long Square or Oblong hath four right Angles, but the Sides are unequal, as *Fig.* 12.

Obliquangled are ſuch as have oblique Angles, *viz.* two obtuſe, and two acute, of which there are two ſorts, the *Rhombus*, and the *Rhomboides*.

A *Rhombus* hath equal Sides, but no right Angles.

The *Rhomboides* hath only the oppoſite Sides and Angles equal, as in *Fig.* 13. & 14. in *Plate* 11.

All other four-ſided Figures are called *Trapezias*, which have no equal Sides or Angles, but are regularly Quadrangular, as *Fig.* 16. and may be divided into two Triangles, by drawing a Line from one Angle to the oppoſite Angle, which is called the Diagonal.

Multangular or *Multilateral Figures*, are either Regular or Irregular. Regular Multangular Polygons or Figures, take their Names from the num-

ber of their Sides or Angles, ſo a *Pentagon*, *Hexagon*, *Heptagon*, *Octogon*, *Enneagon*, *Decagon*, ſignifie a Figure of 5.6.7.8.9.10. Sides, and conſequently Angles.

Before I proceed to *Geometrical* Propoſitions, I muſt make known to the young Artiſt, That whatſoever Lines he meaſures upon Paper, or the Ground, whether by Inch, Foot, Yard, or Pole, he muſt have a *Scale* and *Compaſſes* by which the ſame meaſures may be taken off, and ſo laid down upon Paper.

Compaſſes are ſo well known, that I need not deſcribe them, only ſee they open truly on the Rivet, and be well wrought, and good Steel Points; And that they have alſo an Ink and Black Lead Point to draw Circles and Lines upon any occaſion, being very neceſſary for the projecting and laying down any Fortification.

Of the plain Scale.

Scales are of ſeveral ſorts: The *plain Scale*, which conſiſt of certain Lines divided into equal parts, upon Plates or broad Rules of Box or Braſs, is divided into great equal parts, which ſignifies Tens, and are numbred 10, 20, 30, 40, 50, *&c.* according to the length of the Lines. Again, one of theſe great Diviſions are ſubdivided into ten equal parts, and according to the number of theſe little parts contained in an Inch, 'tis made a Scale of 10, 12, 16, 20, 30, 40, 50, *&c.* equal parts in an Inch. Upon this Scale there muſt be alſo three, four, or more *Lines of Cords* to ſeveral *Radius's*, which

which are useful for many purposes in Fortification, and in other Mathematical Projections.

Of the Diagonal Scale.

A *Diagonal Scale* is made upon 11 parallel Lines equidistant, so as to include 10 equal Spaces, which are all cut at right Angles by Traverse or Diagonal Lines, dividing them all into 10 equal parts, and numbred upwards from *a. b.* which separates between the Hundreds and Tens; the Hundreds are numbred downwards, 1, 2, *&c.* to 12, if the Scale be a Foot long; the Tens are numbred upwards, with 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. which represent 10, 20, 30, *&c.* to the top where the Parallels are marked 1, 2, 3, 4, *&c.* to 10 representing Unites. So that by what hath been said, and by inspection of the Figure, the Uses will plainly appear: For suppose I would set off 169 Feet, Yards or Rods, I find first below *a. b.* 1. for 100, then 6. for 60 on the side, then for 9 at the top, and at that Intersection of 6. and 9. at *d.* and upon that parallel Line *c. d.* take that distance off with your Compasses, and set it off upon your Draught, as required.

Of Chains.

That of *Gunters* is now most in use, and contains in length four Statute Poles or Perches, each Pole containing 16 Feet and $\frac{1}{2}$, or 5 Yards and $\frac{1}{2}$, so that the whole *Chain* is 66 Feet, or 22 Yards long. This whole *Chain* is divided into 100 equal Parts or Links, whereof 25 are just a Pole or Perch,

and, for ready counting, there is usually some remarkable distinction, by some Plate or large Ring at the end of every 25 Links, especially at the middle of the Chain; and at the end of every 10th Link, 'tis usual to hang some small Curtain Ring, or some other distinction; as also at every 5th some different mark, which makes it the more ready for use in measuring.

CHAP. II.

Of Geometrical Problems.

THE Uses of which, are to teach the ingenious Student readily to measure whatsoever is Quantity, Dimensions of Bodies, Distances on *Sea* or *Land*, Heights and Depths of Trees, and Towers, Hills and Mountains, or the *Earth* itself, nay, the Heights and Distances of the Heavenly Bodies, *Sun*, *Moon*, and *Planets*.

Prob I. Plate 11. Fig. 1.

Of a Line, and how to draw it on Paper, or on the Ground.

A strait Line is usually drawn upon Paper with a Ruler, and by turning the Ruler end for end, as *a.* where *b.* was, you may try whether it draws a strait Line or no, for then if it exactly trace or cut by a Point the same Line again, the Ruler is strait.

ſtrait. To draw a ſtrait Line upon the ground if level, as between *a.* and *b.* ſet up ſome marks or prickets, as *c.* and *d.* ſo as they may cover or be in a right Line, with *a. b.* ſtanding at *a.* and ſo by them or more, if need be, with a Line or Chain one length after another, you may mark out the Line *a. b.* But if any Hill or riſing Ground be betwixt *a.* and *b.* then muſt the two marks at *c.* and *d.* be ſo placed as to cover *b.* and from *c. b.* to cover *a.*

Prob. II. Fig. 2.

To draw a Line parallel to another, at any diſtance aſſigned.

Open your Compaſſes to the diſtance given, ſuppoſe *c.* ſet your Compaſſes in *c.* and take the neareſt diſtance to the Line *a. b.* with which ſetting one Point in any convenient part of the Line *a. b.* deſcribe the Arch *d.* to whoſe convexity if you apply a ſtrait Ruler from *c.* the parallel Line is drawn, by the ſame direction you may draw it upon the Ground, ſetting off your diſtance with the Chain, Cord, or Rod-pole.

Prob. III. Fig. 3.

To raiſe a Perpendicular upon any Line given, either upon Paper, or upon the Ground.

Suppoſe the point *a.* in the Line *c. b.* were the point aſſigned in the Line given, open your Compaſſes to a convenient diſtance, and with one Foot in *a.* mark

mark out the Points *c.* and *b.* then opening the Compaſſes ſomwhat wider, ſetting one Foot in *c.* and *b.* ſeverally deſcribe the two Arches cutting one another at the Point *d.* from which if you draw a Line to *a.* the work is done. To do this upon the Ground, take with a Line or Rule equal diſtances from *a.* to *c.* and from *a.* to *b.* then with a larger diſtance from *c.* and *b.* mark out the Point of Interſection at *d.* or it may be done by a Quadrant, or other Inſtrument with ſights, placing the beginning of the Inſtrument upon the Line *c. b.* and turning the ſights to 90 degrees, that Line will be perpendicular.

Prob. IV. Fig. 4.

To raiſe a Perpendicular at the End of a Line.

On the Point *a.* as a Centre, deſcribe part of a Circle *b. c. d.* with that diſtance mark out the Point *c.* from *b.* then ſetting one Foot in *c.* make a Point at *d.* upon which Points *c. d.* croſs an Arch at *e.* then lay a ſtrait Ruler from *a.* to *e.* which is the Perpendicular. Or in caſe you cannot conveniently come to make a point at *d.* then deſcribe the arch *b. c.* and with that diſtance mark out the Point *c.* as before, then lay a Ruler from *b.* to *c.* and croſs the Arch at *e.* at which Inteſrection a ſtrait Line or Ruler to *a.* is a Perpendicular. Or laſtly, divide *a. b.* into five equal Parts, and taking 4 of them with your Compaſſes, ſet one Foot in *a.* and deſcribe an Arch

at

at *c.* then take the distance from *a.* to 5, and placing one Foot in 3, with the other cross the Arch at *c.* at which Intersection a strait Ruler laid to *a.* will be a Perpendicular, as *Fig.* 5.

After this manner you may raise a Perpendicular on the Ground by the Foot Chain, setting off 40 Foot from the Point *a.* to *b.* then setting off 50 Foot from *b.* to *c.* and 30 Foot from *a.* to *c.* is the Perpendicular for 5, 4, and 3, describe a right angled Triangle, *Fig.* 6.

Prob. V. Fig. 7.

To let fall a Perpendicular from any Point assigned.

With your Compasses set one Foot in *a.* and describe the Arch *b. c.* again with that distance upon *b.* and *c.* cross an Arch, as at *d.* so a strait Line from *a.* to *d.* will be the Perpendicular required.

Another way, as at *Fig.* 8. towards the end of a Line, as at *d.* draw the Line *d. b.* which divide in half at *c.* then with that distance draw the Semicircle *d. a. b.* cutting the Line at *b. a.* in *n.* so shall a Line from *b.* to *a.* be the Perpendicular required.

Note, That all these Problems may more easily be performed by help of a small Square exactly made, or with any Quadrant, by applying one Leg of such a Square or Quadrant to the Line given, you may by the other Side or Leg that toucheth the Point, draw the Perpendicular.

Prob.

Prob. VI. Fig. 9.

Any three Lines given, to make a Triangle of them.

Let the Lines given be *a. b. c.* with your Compaſſes take the length of the Line *a.* and ſet it off from *d.* to *e.* ſo alſo the Line *b.* and ſet one Foot in *d.* and deſcribe the Arch at *f.* then take the length of the Line *c.* and with that diſtance ſet one Foot in *e.* and croſs the Arch made before at *f.* then from that Interſection draw the Line *e. f.* the Triangle is finiſhed.

Note, That if all the Sides, or two of them be equal, the method is the ſame; and by this direction you may draw any *Trapezium*, the Diagonal and Lines being given.

Prob. VII. Fig. 10.

An Angle given, to make another equal to it.

Let the Angle given be *b. a. c.* firſt take off the length of *a. b.* and ſet it off as *f. d.* and deſcribe the Arch *f. e.* upon the Point *d.* then taking the diſtance *c. b.* ſet it off from *f.* to *e.* ſo a Line drawn from *d.* to *e.* will make the Angle *e. d. f.* equal to the Angle *b. a. c.*

Here Note, That in the equality or inequality of Angles, we never regard the length of the Lines; for that is the greateſt Angle, whoſe Lines are further diſtant one from another at the ſame diſtance from the angular Point, or Interſection of the two Lines.

Prob.

Prob. VIII. Fig. 11.

To measure an Angle.

Every Angle is measured by that Arch of a Circle described on the angular Point, *viz. a.* is the angular Point of the Triangle *b. a. c.* and *b. c.* is the arch or measure of it. Now every Circle is supposed to be divided into 360 degrees, every degree into 60 minutes, *&c.* therefore the arch *b. c.* must be so many degrees and minutes of the whole Circle *b. c. d. e. f.* which to measure, you must have a Circle or Semicircle, called a Protractor. Or by a line of Cords, by either of which you may thus measure the Angle, *viz.* let the Angle be *b. a. c.* place the Centre of your Circle or Protractor so on the Point *a.* that the beginning thereof may lie on the Line *a. c.* so shall the number of degrees intersected between *b.* and *c.* be the measure of the Angle, which here is 45 *d.* for *c. d.* is 90 degrees, or a quarter of a Circle, and *c. b.* is half of it. If you use the line of Cords, you must take off 60 degrees with the Compasses, and describe the arch *b. c.* then take the distance *b. c.* with your Compasses, and that distance applied to the Scale, will give the measure of the Angle *b. a. c.* 45 degrees, as aforesaid.

Prob. IX. Fig. 12.

To make a true Square upon any Line given.

Let the Line given be *a. b.* upon one end, as at *a.* raise

raiſe a Perpendicular, as *a. c.* then take the length of *a. b.* with your Compaſſes, and with one foot in *a.* ſet off that diſtance to *c.* upon which point, and at the ſame diſtance, croſs an arch at *d.* and with that ſame diſtance ſet one foot in *b.* deſcribe an arch croſſing the other, from which Interſections a Line drawn to *d.* and to *b.* finiſh the Square *a. b. c. d.* The ſame direction will ſerve to make a long Square, the length and breadth being given.

Prob. X. Fig. 13.

To make a Rhombus, one Side being given.

If the Angles be not limited, draw any Angle at pleaſure, and let the Line given be *a. b.* which being taken with your Compaſſes, ſet it off from *a.* to *c.* equal to *a. b.* then with the extent of *a. b.* upon the point *c.* croſs an arch at *d.* in like manner at *b.* deſcribe another arch, croſſing the other at *d.* at which Interſection draw the Line *d. b.* and *d. c.* Note, If any Angle be given with the Side to limit the Content, you muſt ſet off the Angle by *Prob.* and then ſet off the Lines as directed.

Prob. XI. Fig. 14.

To make a Rhomboides, the Sides being given.

If neither the Angle nor Diagonal be given, then make any Angle, as here *b. a. c.* then ſuppoſing if the Lines given be *f. e. h. g.* ſet the length of *g. h.* upon *a. c.* and *f. e.* on *a. b.* then with that extent

extent of the Compaſſes, ſet one foot in *c.* and make an arch at *d.* then take the length of *g. h.* and with your Compaſſes one foot in *b.* croſs the arch made before at *d.* from which Interſection draw Lines to *b.* and *c.* and finiſh the *Rhomboides.*

Prob. XII. Fig. 16.

To make a Trapezium, *the Diagonal and Lines given.*

The Diagonal is a right Line, paſſing through the midſt of any Figure from one oppoſite Angle to another, and dividing it into two equal Triangles, which Line let be *e. f.* whoſe Sides are the Lines *a. b. c. d.* with your Compaſſes take the length of the Line *a.* and place one foot in *e.* and with the other deſcribe the arch at *g.* then take the length of the Line *b.* and with one foot in *e.* deſcribe the arch at *h.* then taking the length of the Line *c.* with one foot in *f.* croſs the arch at *g.* and taking alſo the length of the Line *d.* in the point *f.* croſs the arch at *h.* ſo ſhall Lines drawn from thoſe Interſections, make the *Trapezium* required *e. f. g. h.*

Prob. XIII. Fig. 15.

Any three Points given, how to deſcribe a Circle that ſhall paſs through them.

Any three Points make a Triangle, as *Fig. a. b. c.* therefore to draw thoſe three Points into a Circle, is but to cut any two Sides *d. b.* or *d. c.* into two equal

equal parts by *Prob. III.* and draw the ſtrait Lines; for at the point of their Interſection, as at *d.* is the Centre where the foot of the Compaſſes muſt be ſet in, to deſcribe the Circle that will paſs through thoſe three Points.

Of the Meaſure of Lines.

The common Meaſures uſed in *England* are expreſſed in the following Table from one Inch to a Mile, both in long Meaſure, and in ſquare Meaſure.

And here it will be very requiſite to know,

Firſt, That Timber, Stone, Earthwork, as Gardens, Alleys, Board, Glaſs, *&c.* are meaſured by the Foot.

Secondly, That Lands, Woods, Brickwork, *&c.* are meaſured by the Perch or Pole.

Thirdly, That Pavings, Plaiſterings, Wainſcotings, are meaſured by the Yard. All linen and woollen Cloth, Stuffs, Silks, *&c.* are by the Yard Ell.

Fourthly, Carpenters Works, as Flooring, Partitioning, Roofing, Tyling, the Ground-plot of Houſes and whole Buildings, are meaſured by a Rod of 10 foot long. That, every way laid out or multiplied by itſelf, is called a Square, containing 100 ſquare feet.

A Neceſsary Table for Menſuration of Superficiall Meaſures

/	Inches.	Centeſme.	Feet.	Yard.	Pace.	Pearch	Chain	Acre	Mile
Inche.	1	7. 92	12	36	60	198	792	7920	63360
Centeſm.	62726	1	1. 515	4. 56	7. 575	25	100	1000	8000
Feet.	144	2. 295	1	3	5	16. 5	66	660	5280
Yard.	1296	20. 755	9	1	1. 66	550	22	220	1760
Pace.	3600	57. 381	25	2. 778	1	3. 3	13. 2	132	1056
Pearch	39204	625	272. 25	30. 25	10. 89	1	4	40	320
Chain.	627264	10000	4356	484	174. 24	16	1	10	80
Acre.	6272640	100000	43560	4840	1742. 4	160	10	1	8
Mile.	40144896000	6400000	2787840	309760	111536	102400	6400	640	1
/	Inches.	Centeſme.	Feet	Yard	Pace.	Perch.	Chain	Acre	Mile

Of meaſuring of Superficies.

First, To meaſure or find the ſuperficial Content or *Area* of any right lined Figure, you muſt firſt know, that as there is in a Foot 12 Inches, ſo 12 times 12. or 144 ſquare Inches, is a Foot ſquare; ſo alſo as there is 3 Foot in a Yard, there are 3 times 3, *viz.* 9 ſquare Feet in a Yard ſquare, and ſo of the other parts of Meaſure, as in the foregoing Table.

Prob. XIV.

To find the Content of any Triangle.

Secondly, The Content of all Triangles, whether right, acute, or obtuſe angled, is found by multiplying the whole Baſe of the Triangle by half of the Perpendicular let fall upon the Baſe, or the whole Perpendicular by half the Baſe.

Thirdly, That all right lined Figures, whether

alone, or as parts of 4, 5, 6, or more ſides, may be reduced to Triangles, and by adding up the Contents of all the ſeveral Triangles, their Content found out by the general Rule aforeſaid, which therefore ought to be remembred. To make this plain, being of ſo general uſe, I ſhall make one Example, *viz.* ſuppoſe in *Fig.* ix. *d. e.* the Baſe of the Triangle is 44 Feet, and the Perpendicular *f. b.* to be 20. Now whether you multiply the whole Baſe *d. e.* 44, by half the Perpendicular *f. b.* 10. or multiply 20. the whole Perpendicular by 22. the half of the Baſe, the Product gives the Content 440 Feet, for the ſuperficial Content or *Area* of that Triangle.

Prob. XV.

To find the Content of a Square, or Oblong Square.

Multiply the Length by the Breadth, the Product gives the *Area* or Content, Example *Fig.* xii. let the *Square* be

17 Inches length
17 Inches breadth

119
17

289

multiply one ſide by the other, the Product is the number, *viz.* 289 ſquare Inches contained in that Square, ſo ſo alſo ſuppoſe *Fig. xiii.* one ſide to be 25, the other ſide 13 which multiplied together, produceth 325 ſquare Feet.

13
25

65
26

325

Prob.

Prob. XVI.

To find the Area, *or Content of a* Rhombus *or* Rhomboides.

Let fall a Perpendicular from one of the obtuſe Angles upon the oppoſite ſide, that ſide multiplied by the Perpendicular, gives the *Area*, *Fig.* xiii. the ſide *d. b.* 20 yards, the Perpendicular 14 give 280 ſquare yards. For the *Rhomboides* divide it into two Triangles by a diagonal line drawn between either pair of the oppoſite Angles, as *a. d.* in *Fig.* 14. then from the oppoſite Angles either at *c.* or *b.* let fall a Perpendicular upon that Diagonal, as *b. o.* then multiply the length of the Diagonal by the Perpendicular *b. o.* and then you have the *Area*.

20
14
—
80
20
—
280

Example: Suppoſe the { Diagonal 19 Rods. / Perpend. 5 / Content 95

Prob. XVII.

To find the Content of a Trapezium.

Divide it into two parts from Angle to Angle, as *Fig.* 16. is divided by the Diagonal *e. f.* then from the other two Angles, *viz. g. h.* let fall Perpendiculars upon the Diagonal. The ſum of half the length of thoſe Perpendiculars being multi-

plied by the ſum of the length of the Diagonal, or common Baſe, gives the ſuperficial Content.

Example: Suppoſe the Diagonal *e. f.* 33 chains.

the Perpendicular *g.*	15
the Perpendicular *b.*	13
The Sum of both Perpendic.	28
the half Sum	14
Being multiplied by the Diagon.	33
	42
	42
The Content or *Area*	462

Of Foreign Meaſures.

The Foreign Meaſures moſt made uſe of in Fortification, are the *Pariſian*, *Rhineland*, and *Venetian* Feet, which, in proportion to the *Engliſh* Foot, divided into 1000, are as followeth:

Pariſian	*Rhineland*	*Venetian*
1.1068	1.1033	1. 1152
2.2136	2.2066	2. 2304
3.3204	3.3099	3. 3456
4.4273	4.4133	4. 4608
5.5340	5.5166	5. 5768
6.6408	6.6919	6. 6912
7.7477	7.7233	7. 8064
8.8546	8.8266	8. 9216
9.9613	9.9299	9.10368

The uſe of theſe Tables are plain and eaſie, in ſhort thus: Suppoſe I would know how many *Engliſh* Feet are equal to 755 *Venetian*, againſt 700 I find 8064, 50 576, 5 057, which added together, is 8697

And

And the laſt Figure cut off, gives you 869 *Engliſh* Feet equal to 755 *Venetian*. Or if you ſay by the Rule of Three, If 1000 *Engliſh* Feet give 1152 *Venetian*, what ſhall 755. multiply and divide, and you will find 869, as before. Thus you will find 985 *Pariſian* Feet to make 1052 *Engliſh*.

	900	9613	Or if 1000 require
	80	854	1068, what ſhall 985,
Example:	5	53	which multiplied and
			divided, gives 1052, as
	985	1052|0	before.

Here Note, That the *Engliſh* Rod or Pole is 16 Foot and an $\frac{1}{2}$, but the Rod of 10 Foot is beſt for uſe. That the *French* reckon by the *Toiſe*, which is 6 of their Feet for a Meaſure in Fortification. The *Venetian* account by the Pace, which is 5 of their Feet. The *Dutch* by the Rod of 12 of their Feet.

Prob. XVIII.

To find the Content of a Regular Polygon.

Draw a Line from the Centre to the middle of any ſide, half of the Perimeter (or half of the ſides,) being multiplied by that Line, gives the Content.

Example: Admit the *Polygon* be the *Hexagon* in *Fig.* 18. whoſe ſides are 700 Feet, 6 times 700 is 4200. the half of which is 2100, which multiplied by the Perpendicular, which is 602, gives 1264200 Feet for the Content of the *Polygon*.

This Estimate being only in square Feet, will want a Reduction to a higher Denomination, I have therefore, for such like Cases, added the Table of Square Measure, by which you may, by Inspection, find out any Denomination.

Example: Suppose I would reduce the aforesaid Number into Acres, I therefore look into the Table, and find Feet in the top, and Acres on the side, and in the Column answering thereunto, I find 43560 Feet to make one Acre, I therefore divide 1264200 by 43560, the Product whereof is 28 Acres, and 4510 Feet, which by the same way I find to be 1 Chain, and 164 Feet, the Content of the *Polygon* required.

Prob. XIX.

To find the Content of an Irregular Polygon.

Divide it into *Trapezia's* and Triangles by Diagonals, then find their Content severally, and sum up altogether.

Example: Suppose *Fig.* xix. an irregular *Polygon* divided into 3 Triangles by the Lines *a. b. a. c.* and *d. b.* whereof two of them being upon the same Base *d. b.* make up a *Trapezium*, whose Content may be found, as was taught in *Prob.* 17. then there remains the Triangle *a. e. b.* whose Content may be found by *Prob.* 14. then adding the Content of the *Trapezium* to the Content of the Triangle, you have the *Area* or Content of the whole *Polygonian* Figure.

Come we now to the Art of Fortification.

CHAP.

CHAP. III. Plate III.

The Diviſion of Fortification.

FOrtification, or Military Architecture, is a Science how to defend and fortifie any Place, ſo that all parts of it may mutually defend and aſſiſt each other againſt the Force of an Enemy.

The Diviſion of Fortification.

The whole Art is divided into eight Parts, viz. *Defenſive*, *Offenſive*, *Natural*, *Artificial*, *Ancient*, *Modern*, *Regular*, and *Irregular*.

Defenſive Fortification ſhews how a Place is to be defended againſt all Force and Violence of an Enemy.

Offenſive Fortification ſhews how to Beſiege, and take a Fortified Place.

Natural Fortifications have theſe Advantages, they cannot eaſily be undermined, they are naturally ſtrong, difficult to be ſcaled, may be built up with ſmall Charge, and are moſt eaſie to be defended.

In *Artificial Fortifications* there ought to be conſidered the ſituation of a Place, the nature of the Earth, the condition of the adjacent Country, and the Figure.

Ancient Fortification was plain and rude, as all Beginnings are wont to be. At firſt Walls were raiſed to ſuch a Height, as might keep off the Enemy from an eaſie Aſcent by Ladders, and Loop or Port-holes were made in the Wall. Afterwards they added to the Walls a Breaſt-work, the Top whereof was left open at certain Diſtances, ſo that covered with their Battlements they might defend themſelves, and through thoſe Intervals beat off the Enemy. After this were made round Terrets or Towers to cover the Walls, and to add more ſtrength to them.

Modern Fortification is that way of Defence which is now uſed, turning the Walls into Ramparts, the round Towers into Bulwarks, fitted with Face and Flank, and encloſing the whole with right or ſtrait Lines, ſo that all parts of the Fortification ſecure and defend each other.

Regular Fortification is, when a Place or Town hath equal Sides or Angles.

Irregular Fortification is, when a Place hath unequal Sides, and unequal Angles.

CHAP. IV. Plate IV.

A further Definition of Fortification.

FOrtification is alſo divided into three principal Parts, viz. *Ichnographie*, *Orthographie*, and *Sc[illegible]ographi*.

Ichno-

Ichnographie is a Repreſentation or Ground-plot of any Fort or other Work either made, or to be built, drawn or delineated on Paper, ſhewing and deſcribing its Form and Proportion, with all its Lines and Angles, and all other parts belonging to it.

Orthographie, or *Profile*, is a perpendicular or upright Draught of any Fortification as it doth preſent itſelf to the view being finiſhed, ſhewing all the Breadths, Heights, Depths and Lengths of the Rampart, Parapet, Ditch, or Covert-way, *&c.*

Scenographie is the Model or Draught of any Work preſented with its ſhadows, according as the Work itſelf ſhews with its Dimenſions according to the Rules of Proſpective, all which will more plainly appear to the underſtanding, by *Plate* IV.

CHAP. V. Plate V.

The Definition of the principal Lines and Angles in the Ichnography, *according to the* Latin, French, *and* Engliſh.

THE principal Line to be regarded in all Fortifications, is the outward or exterior Line bounding the Rampire, at the Foot next to the Ditch, from which Baſis all the reſt of the Lines depend. Latin.

	Latin.	French.	Engliſh.
GFEBMZL	*Vallum & Munimen.*	*Rampart.*	*Rempire.*
EM	*Cortina & Chorda.*	*Courtine.*	*Curtain.*
M. z or EF	*Ala propugnaculi.*	*Flanq ou le Flanc*	*The Flank.*
CE	*Collum.*	*La demi gorge.*	*The Gorg or Neck.*
CB	*Capitalis.*	*Capitale.*	*The Capital.*
Gm or EL	*Linea defenſionis figens.*	*Ligne de deffenſe Fichante.*	*The fixed Line of Defence.*
GK or LO	*Linea ſtringens.*	*Ligne raſante, ou Flanquente.*	*The flanking Line of Defence, or Line ſtringent.*
EO	*Ala Cortinæ.*	*Second Flanc, ou Flanc oblique.*	*Second Flank.*
GF	*Facies propugnaculi.*	*La Face.*	*The Face.*
z o or FK	*Liberum ſtringentis.*	*Face prolongee.*	*The Face prolonged.*
Fy	*Alæ continuatio.*	*Flancq prolongee.*	*The Flank prolonged.*
EFGHI	*Propugnaculum vel munitio.*	*Baſtion, ou Boulevart.*	*A Bulwark, or Baſtion.*
CD	*Latus Arcis.*	*Coſte du Polygone interieur.*	*The inward Polygon.*
GL	*Latus multanguli exterioris.*	*Polygone exterieur.*	*The outward Polygon.*
QD or QC	*Radius Caſtri.*	*Le petit Demidiameter.*	*The little Semidiameter.*
QL or QG	*Radius multanguli exterioris.*	*Le grand Demidiameter.*	*The great Semidiameter.*
CQD	*Angulus Centri.*	*Angle du centre.*	*Angle of the Centre.*
CDX	*Angulus Figuræ.*	*Angle Polygone.*	*Angle of the Figure, or of the Polygon.*
HGF	*Angulus propugnaculi, & Angulus defenſus.*	*Angle Flanque, ou Angle du Baſtion.*	*Angle of the Baſtion.*
EKF or mzo	*Angulus alæ ſubtenſus ſive angulus ſtringentis & Cortinæ.*	*Angle Flanquant interieur.*	*The Angle of the Curtain, and flanking Line of Defence.*
EFK or mzo	*Angulus ſubtenſus complemento Cortinæ, ſive Angulus ſtringentis & alæ.*	*Angle de la Flanquante & du Flancq.*	*The Angle of the Flank, and flanking Line of Defence.*

	Latin.	French.	Engliſh.
GFE or mzl	*Angulus Faciei & Alæ.*	*Angle du Flancq & de Face, ou Angle de l'Eſpaule.*	*Angle of the Face and Flank.*
G R L	*Angulus decuſſationis, vel Angulus defendens.*	*Angle de Tenaille, Angle flancquant exterieur.*	*Angle of the Tenail.*
E C F or	*Angulus determinans Alam.*	*Angle Forme Flancq.*	*Angle forming the Flank.*

Note alſo, that *A. B.* is the Baſe of the Rampire, *B. P.* the breadth of the Ditch or Moat, *B. R.* the Eſcarpe or Slope of the Ditch next to the Wall, *S. P. S.* is the Contraſcarpe, that is, the ſloping of the Moat contrary to the Eſcarpe, *P. T.* is the Covert or cloſe way which is left above the Moat next the open Field, *T. V.* is the *Glacis* or Eſplanade, a kind of Parapet which loſeth itſelf inſenſibly, level with the Earth, *M. N.* Cazemates or Retreats made in the Flank to fire upon the Enemy.

Of the general Parts of Fortification. *Plate* VI.

The whole Art of *Fortification* is principally comprehended in two general Parts, the firſt of *Defence*, the ſecond of *Offence*.

The *defenſive* part ſhews how a Place is to be defended againſt the force and violence of an Enemy, and conſiſts chiefly in theſe five following Parts.

1. In the principal Works of a place, which are *Bulwarks*, and the *Curtain* between them, *&c.*

2. In

2. In the Outworks, which are the *Moat* or *Ditch*, the *Ravelins*, *Half-Moons*, *Tenailes*, *Horn* and *Crown-Works*, &c.

3. In the inner Buildings, which are the *Armories*, *Magazines* or *Store-houſes*, *Corp de Gards*, *Bridges*, *Mills*, *Houſes*, &c.

4. In the accidental Works, which are *Retrenchments*, *Counter-approaches*, *Countermines*, &c.

5. In the Gariſon, or ſufficient number of Men, with the *Ammunition*, *Arms* of all ſorts, great and little *Guns*, with all other Stores and Proviſion whatſoever. All which are repreſented in *Plate 6. viz.*

A. is a City or Town.
B. the Magazine, Storehouſe, or place of Rendezvous.
C. The Market-place.
D. The Ground-plot of the Houſe.
E. The Streets.
F. The Cittadel or Caſtle.
G. The Governor's Houſe.
H. The Hutts or Lodgments of the Soldiers.
I. Is a Baſtion or Bulwark.
L. Is a Baſtion with Cazemates, with the Port-holes or Embrazures.
M. A Platform.
N. A Cavalier.
O. Is a Contramine.
P. Is a Retrenchment.
Q. Repreſents the great Buildings, *viz.* Churches, and other publick places.
R. Is the Rampire with its Parapets, *&c.*
S. Is the Ditch or Moat.

T. The

T. The Foreland, Barm, Liſire, or Cordon by M. *Mallet.*

V. The Bridge.

W. Is a Ravelin.

X. Is a Half-moon.

Z. Is a ſingle Tenaile; 1. is a double Tenaile; 2. is a Swallow Tail, *Ouvrage a Quevé Ironde*, in *French*; 3. is an Hornwork; 4. is a Crown-work; 5. is a Crowned Hornwork; all which Parts we ſhall more particularly explain in the following Diſcourſe.

CHAP. VI.

Of the general Canons and ſpecial Rules which are to be obſerved in all Fortifications.

IN fortifying any Place, there is to be obſerved theſe ſix following Parts, *viz.*

1. The *Defence.* 2. The *Offence.* 3. The *Earth.* 4. The *Nature* or *Situation* of the Place. 5. The *Nature* of the adjacent Country. 6. The *Form* or *Figure.*

For defending a Place, obſerve theſe following Rules in the *Ichnography.*

Firſt,

First, The *Form* of a *Fort* muſt be ſuch, that all its Parts may *flank* and be *flanked*, that is, defend one another.

Secondly, The *Fichant* or *fixed Line* muſt not exceed a Muſquet-ſhot. The beſt Proportion, ſaith *Taquet*, will be 750 or 720 Feet. Sir *Jonas Moor* ſaith, The Line of Defence fixed, or which is near equal to it, *viz.* the inferior *Polygon* muſt not be longer than 800 Feet, nor ſhorter than 500. *Borcklern* ſaith not under 60, and not above 70. *Rhyneland* Perches, *Travaux de Mars* 120 *Toiſes*.

Thirdly, The *Baſtion* or *Bulwark* muſt not be too great nor too little, but ſuch as may receive a ſufficient number of Men, and afford room enough for the traverſing Guns, and performing other Military Duties.

Fourthly, The *Angle* of the Bulwark muſt not be leſs than 60 degrees, nor much more than 90; for if it be too ſlender, 'tis eaſily batter'd by the force of the Cannon; if too obtuſe or blunt, 'twill be the ſooner beat open at the Point.

Fifthly, The greater the *Angle* that is made by the outward *Polygon*, and the Face, the greater is the defence of the Face. And this Maxim Sir *Jonas Moor* holds ſo eſſential, that it ſhall try the goodneſs of all Inventions for what kind of *Fortification* ſoever.

Sixthly, The *Angle* of the *Flank* and *Courtain* muſt always be a right *Angle*, that ſo as well the *Courtain* as the *Face* may be the better defended, and the *Angles* of the *Face* and *Flank* be the ſtronger: But Sir *Jonas Moor* ſaith, There is no more Virtue in a *Right Angle* than in another. And the Inge-

Ingeniers of this Age leſſen the *Angle*, keeping notwithſtanding a due ſtrength for it, rather than want the *Flank* in the *Courtain*: For that *Fort*, ſaith *Taquet*, is far the ſtrongeſt, which keeping the reſt of the Maxims, hath alſo *Flanques* in the *Courtain*; And without which, *Borcklern* tells us, a *Fort* is imperfect.

Seventhly, The *Face* of a *Bulwark* ſhall not be ſhorter than the half of the *Courtain*, nor longer than the whole. The *Flank* muſt not be leſs than the 4th part of the *Face*, nor bigger than half the *Face*. And the *Gorge* or *Demigorge Line* muſt not be much longer or ſhorter than the *Flank*; in theſe three *Dogen* and *Goldman* agree.

Eightbly, In ſhort, That Form of a *Fortification* will be the beſt, that hath the largeſt *Flanks* in the *Baſtion* and *Courtain*, the *Gorge Lines* very large, the *Angle* of the *Baſtion* a *Right Angle*, or near to it, and the *Fichant Line* of Defence at moſt not exceeding a Muſquet-ſhot.

CHAP. VII.

BEfore I proceed to the laying down any *Fortification*, I ſhall ſhew how to deſcribe the *Polygons* themſelves; and firſt,

Prob.

Prob. VII. Fig. 1.

How to inſcribe any Figure *or* Polygon *within any* Circle.

Let *a. d. b. e.* be a *Circle* given, and it is required to find the ſide of

A *Regular Figure* made of	*Sides* or *Angles*, containing	Degrees or parts of a *Circle* at the Angles of their *Centre*, and deſcribeth a	whoſe *Angle* at the *Figure* or *Polygon* containeth	The Complement to 180.
4	180	*Triangle*	60	
3	90	*Tetragon*	90	
5	72	*Pentagon*	108	
6	60	*Hexagon*	120	
7	51 $43\frac{1}{2}$	*Heptagon*	128 $34\frac{1}{2}$	
8	45	*Octagon*	135	
9	40	*Enneagon*	140	
10	36	*Decagon*	144	
11	$32\frac{8}{11}$	*Hendecagon*	$147\frac{7}{11}$	
12	30	*Dodecagon*	150	

First, Through the *Centre c.* draw the *Diameter* or Line *a. c. b.*

Secondly, Take with your *Compasses* half the *Diameter a. c.* or *c. b.* and setting one foot in *a.* with the other make the marks *f. g.* and draw the line *f. h. g.* which shall be the side of a *Triangle* that will be inscribed in that *Circle.*

Thirdly, Draw the line *d. e.* through the *Centre c.* cutting the *Diameter a. b.* at *Right Angles*, and draw the line *a. d.* which shall be the side of a *Square*, which will be inscribed in that *Circle.*

Fourthly, Set one foot of the *Compasses* in *h.* and extend the other to *d.* and draw the *Arch d. i.* then draw the Right Line *d. i.* which shall be the side of a *Pentagon.*

Fifthly, Any of the *Semidiameters c. a. c. d. c. b.* or *c. e.* are the sides of an *Hexagon.*

Sixthly, Half of the line *f. g.* viz. *h. f.* or *h. g.* are the sides of an *Heptagon.*

Seventhly, Divide the line *a. d.* into two equal parts, as at *o.* and draw the line *c. o. k.* so shall a line drawn from *a.* to *k.* be the side of an *Octagon.*

Eighthly, Divide the half of the *Circle* line *f. a. g.* into 3 parts, and a strait line from *g.* to one of them, *viz.* at *p.* will be the side of a *Nonagon*, or *Enneagon.*

Ninthly, The line *c. i.* is the side of a *Decagon.*

Tenthly, The half of the line *h. i.* will be the side of an *Endecagon*, and that distance *f. d.* gives the side of a *Dodecagone* that may be inscribed in this *Circle.* Or any *Circle* being drawn from any *Protractor*, or a line of *Chords*; if from the same you take any of these Numbers off with your

Compaſſes, and work ſo many times as your *Figure* hath ſides, you will deſcribe the *Figure* deſigned. Or a *Right Line* drawn from each end of the Line given to its oppoſite *Side* and *Angle* at the *Interſection*, gives the *Centre* of a *Circle*, which ſhall divide it into the *Sides* of the Line given.

Prob. II. Fig. 2. Plate VII.

To deſcribe a Circle *to contain any* Polygon, *whoſe Sides muſt be anſwerable to the Line given.*

Suppoſe *a. b.* the Line given, then with that diſtance deſcribe an *Equilateral Triangle*, as by *Prob. VI.* then from the *Centre c.* in the middle of *a. b.* draw a ſtrait Line *d. e.* as by *Prob. III.* which croſs at *Right Angles* through the *Centre*, as the Line *f. g.* then at the Point *c.* and open your *Compaſſes* to *d.* and with that diſtance deſcribe the *Circle a. f. e. g. b.* then with the ſame diſtance with one foot in *e.* make a croſs at *h*, and with one foot in *g.* mark out *i.* ſo is the *Quadrant e. g.* divided into three parts, which divide again each into three more, ſo is the *Quadrant* divided into nine parts or degrees, numbred 10. 20. 30. to 90. then with one Point of your *Compaſſes* in *c.* extend the other to *g.* at 90. and ſo croſs the Line *d. e.* at 3. then open the *Compaſſes* to 80. and croſs the Line *d. e.* at 4. ſo to 70. and croſs the Line *d. e.* at 5. ſo alſo to 60. which will cut the Line *d. e.* in the *Centre c.* or 6. and ſo on to 10. and 12. ſo that each Point 3. 4. 5. *&c.* be a *Centre* to deſcribe a *Circle*, which ſhall contain a *Polygon* of ſo many *Sides* as is numbred on the ſeveral *Centres*, ma-

making the Line *a.b.* equal to the *Sides* of each *Polygon* as was required. And thus may you make any *Line of Chords* to any *Circle* or *Radius* whatsoever.

Porb. III. Fig. 3. Plate VII.

How to delineate any Regular Fortification *upon Paper*, Geometrically, *two ſeveral ways.*

Firſt, Suppoſe an *Hexagon*, whoſe *Side* or *Polygon interior* is *c. d.* upon half of which, as *c. f.* make a *Square c. f. h. g.* and draw the Lines *a. c.* and *a. d.* and draw the *Diagonal* Line *h. f.* which cuts the half *Diameter a. c.* at *i.* from which Point let fall the *Perpendicular i. k.* which is the length of the *Capital Line*, which ſet off from *c.* to *l.* and from *d.* to *r.* then draw the Lines *l. f.* and *f. r.* and from the middle thereof, as at *m.* and *s.* let fall *Perpendiculars* upon *c. d.* at *n.* and *t.* ſo is *l. c. Capital*, *l. m.* the *Face*, *m. n.* the *Flank*, *c. n.* the *Gorge*, *n. t.* the *Curtain.* This do for the reſt of the *Baſtions*, ſo ſhall the *Ground-plot* be deſcribed.

Here is to be obſerved, 1. That the diſtance between the points of the *Baſtions* in *Great Royal* are always 80 *Rods.*

2. That the *Face-line* is always the half of the Line of *Defence.*

3. That the *Flank* is half the diſtance between both *Polygons.*

4. That the *Courtain* is half of the *Exterior Polygon.*

Prob. IV. Fig. 4. Plate VII.

How to deſcribe any Regular Fortification *upon Paper* Geometrically, *with one opening of the* Compaſſes.

Upon a Line given *b. a.* find the *Centre q.* by *Prob. II.* and draw the Lines *b. q. a.* then at the end of the Line *a.* with its length *a. b.* deſcribe a *Semicircle b. c. d. e.* then with the ſame diſtance at the Points *c.* and *b.* make two *croſs Arches* to cut each other at *f.* from which *Interſection* draw a Line to *a.* and to *e.* and likewiſe from *d.* to *b.* and *a.* and alſo from *g.* to *e.* ſo is *a. h.* the length of the *Gorge*, *h. i.* the length of the *Flank. a. i.* the length of the *Capital i. n.* the length of the *Face.* all which may be ſet off upon the reſt of the *Baſtions*, and ſo may your *Figure* be finiſhed.

CHAP. VIII. Prob. I.

How by a Line of Chords *to deſcribe any* Fortification, *having only two* Angles *given.* Plate VIII. Fig. 1.

LET the Line given be *a. p.* upon *a.* as a *Centre*, with the *Chord* of 60 degrees taken from your *Scale*, deſcribe the *Arch b. c. d.* then from *b.* ſet off half your *Polygon Angle*, which if your

your *Fort* be an *Hexagon*, as here you will find it in the Table in *pag.* 32. to be 120. the half whereof is 60 degrees, which ſet off from *c.* to *f.* and from *c.* to *g.* and draw the Lines *a. b.* and *a. d.* then take off the diſtance of $\frac{1}{3}$ part of the half *Polygon Angle*, *viz.* 20 degrees from the *Line of Chords*, and ſet it from *a.* to *e.* the length of the *Capital.* then draw the Line *e. f.* parallel to *a. b.* which ſhall be the inward *Polygon.* Then upon the Point *e* with the *Chord* of 60 degrees, deſcribe the *Arch h. r.* then ſet off 40 degrees for the *Angle*, forming the *Flank* from your *Line of Chords*, and ſet it off from *h.* to *r.* then draw out the Lines *e. r.* and *a. f.* ſo ſhall the *Interſection* at *k.* mark out the Face of the *Baſtion*, then from *k.* let fall a *Perpendicular k. o.* which ſhall be the *Flank*, and *e. o.* the *Gorge*, and *o. f.* for the *Courtain.* Or let *a. p.* be the *angular Point* of two *Baſtions.* On the *Point a.* deſcribe the *Angles q. a. p.* and *p. q. a.* which in this Figure of an *Hexagon* is 60 degrees, as the *Arch b. c.* then take half the *Angle* of the *Baſtion*, which here is 40. and ſet it from *c.* to *f.* then draw the Line *f. e. parallel* to *a. p.* and proceed, as before directed. The reſt of the *Baſtions* may be ſet off from this, and ſo finiſh your Work.

Prob. II. Fig. 1. Plate VIII.

How to find the Angles *of any* Fortification.

The *Angle* of the *Centre e. q. h.* is found, by dividing 360 degrees by the number of its ſides, as 360. by 5. gives 72. for a *Pentagon.* 360. by 6. gives 60. for an *Hexagon*, &c. The *Angle* of the

Figure or *Polygon h. e. g.* is found by ſubſtracting the *Angle* of the *Centre* from 180. for the *Angle* of the *Centre* and *Angle* of the *Figure* makes two *Right Angles*. The *Angle* of the *Bulwark* or *Baſtion k. a. k.* is found, if to half the *Angle* of the *Figure* you add 15 degrees, ſome add to it 20 degrees. The *Angle a. f. o.* or *k. f. o.* is found, if you deduct ½ the *Angle* of the *Bulwark* from ½ the *Angle* of the *Figure*, for becauſe *e. h.* and *a. p.* are parallel. The *Angle e. a. s.* is equal to *q. e. h.* and *a. f. o.* is equal to *k. a. s.* The *Angle o. k. f.* is had by ſubſtracting the *Angle k. f. o.* from 90 degrees, for ſince *k. o. f.* is a *Right Angle*, *o. k. f.* and *k. f. o.* muſt make another *Right Angle*. The *Angle a. t. p.* will be found, if you double the *Angle k. f. o.* which ſubſtract from 180 degrees, the Remainder is the *Angle o. t. f.* or *a. t. p.* for the *Angle k. f. o.* and *f. u. o.* are equal by conſtruction, therefore *k. f. o.* doubled is equal to them both. Now theſe *two Angles* being known in the *Triangle f. t. o.* the *third* alſo will be known, *Eucl.* 32. 1. and *o. t. f.* is equal to *a. t. p.* by *Eucl.* 15. 1. The *Angle o. k. a.* is found, if you ſubſtract *o. k. f.* from 180. for *o. k. a.* and *o. k. f.* make two *Right Angles*, Eucl. 13. 1. The *Angle a. e. o.* is found by ſubſtracting *g. h. e.* half the *Angle* of the *Figure* found from 180. for *g. h. e.* and *a. e. o.* are equal to two *Right Angles*, Eucl. 13. 1. as aforeſaid.

Prob.

Prob. III.

How any Regular Fortification *may be delineated Mechanically.*

This may be uſeful to them who are not skilled in *Arithmetick*, or who, in great haſte, or in caſe of neceſſity, are forced to entrench themſelves, when the Enemy and Time will not permit to make uſe of much Curioſity and Art.

Example. Fig. 2.

1. Divide the ſide of the *Polygon* given *A. B.* into five equal parts.
2. Take $\frac{1}{5}$ for the *Gorge a. c.* and *g. b.*
3. Upon *c.* and *g.* raiſe *Perpendicular Lines* of an indifferent height.
4. Give $\frac{1}{5}$ to the ſecond *Flank e. c.* and *h. g.*
5. Draw *Lines* from the *Centre k.* prolonged through *a.* and *b.*
6. Apply from *a.* to *f.* and from *b.* to *l.* $\frac{2}{5}$ of the *Line A. B.* for the *Capital Line.*
7. Draw from *f.* to *h.* and from *l.* to *e. blind Lines*, which will cut the *perpendicular Lines* from *c.* and *g.* at *d.* and *i.* and ſo you will have the *Flanks c. d.* and *g. i.* and the *Faces* of the *Bulwarks f. d.* and *l. i.* the *Scale* you may make as you pleaſe, as ſuppoſe from *a.* to *b.* were 600 or 700 Feet, more or leſs, according to which the reſt of the *Lines* have their proportion.

Prob. IV. Fig. 3.

Another way ſet down by Fritach, *to fortifie any* Regular Figure *Mechanically.*

Divide *A. B.* the *Polygon* into three equal parts, $\frac{1}{3}$ gives the Capital *A. C.* or *B. D.* again divide *A. B.* into five equal parts, $\frac{1}{5}$ whereof gives the *Gorge A. E.* or *F. B.* divide alſo *A. B.* into ſeven equal parts, $\frac{1}{7}$ part ſhall be the *Flank E. O.* and *F. H.*

CHAP. IX.

THat the Conſtitution and Ground-lines of a *Fortification* may be found, ſome things ought to be given or known; thoſe things here ſaid to be given, are thoſe *Data's* which an experienced and skilful *Engenier* knows will beſt agree with the Rules eſtabliſhed in *Chap.* VI. and from theſe *Data's* once ordered, the proportion of the reſt of the parts follow ſure and determined, according to the reaſon of the things given; therefore hath our *Author*, with much Care and Pains, made the two following *Tables*, by which are eaſily laid down any *Fortification* required. The *Proportion* of the *Lines* will ſerve for any *Form*, the *Quantity* for the *Royal* only, the *Numbers* are *Rhynland Rods*, and *Centeſmes* of a *Rod* of 12 Feet.

For

First Table for the Lines.

	Semidiameter.	Polygon Inter.	Gorge.	Capital	Flank.	Second Flank.	Courtin	Face.
IV	42 76	60 57	12 24	15 83	7 74	08 94	36 00	24 00
V	52 34	61 54	12 77	17 33	9 09	13 10	36 00	24 00
VI	62 39	62 39	13 19	18 71	10 07	14 02	36 00	24 00
VII	72 68	63 07	13 53	20 03	10 83	13 89	36 00	24 00
VIII	83 15	63 64	13 82	21 29	11 44	13 27	36 00	24 00
IX	93 70	64 10	14 05	22 99	11 61	12 41	36 00	24 00
X	103 38	63 89	13 94	24 07	12 00	12 41	36 00	24 00
XI	114 14	64 33	14 16	24 49	12 00	14 02	36 00	24 00
XII	124 77	64 39	14 29	24 85	12 00	15 22	36 00	24 00

Second Table for the Lines.

	Semidiameter.	Polygon Inter.	Gorge.	Capital	Flank.	Second Flank.	Courtin	Face.
IV	38 14	53 94	8 97	20 01	8 00	06 14	36 00	24 00
V	48 8	56 53	10 26	21 03	9 00	10 58	36 00	24 00
VI	59 19	58 19	11 8	22 15	10 00	11 86	36 00	24 00
VII	68 47	59 42	11 71	23 31	11 00	12 03	36 00	24 00
VIII	78 60	60 31	12 16	24 48	12 00	11 67	36 00	24 00
IX	90 31	61 77	12 89	24 64	12 00	12 95	36 00	24 00
X	101 84	62 94	13 47	24 66	12 00	13 90	36 00	24 00
XI	113 38	63 90	13 95	24 76	12 00	14 63	36 00	24 00
XII	124 77	64 59	14 29	24 85	12 00	15 22	36 00	24 00

For the Angles first Table.

	Angle of the Centre.			Angle of the Figure.			Angle of the Bulwark.			Angle C F A			Angle A C F		
IV	90			90			65			12		30	77		30
V	72			108			72			17		00	73		
VI	60			120			80			20		00	70		
VII	51	25	43	128	34	17	84	17	03	22	8	34	67	51	26
VIII	45			135			87		30	23	45		66	15	
IX	40			140			90		00	25			65		
X	36			144			90		00	27			63		
XI	32	13	38	147	16	22	90		00	28	18	11	61	12	11
XII	30			150			90		00	30			60		

For the Angles second Table.

	Angle of the Centre.			Angle of the Figure.			Angle of the Bulwark.			Angle C F A			Angle A C F		
IV	90		00	90			60			15			75		00
V	72		00	108			69			19		30	70		30
VI	60		00	120			75			22		30	67		30
VII	51	25	43	128	34	17	79	17	09	24	38	34	65	21	26
VIII	45		00	135			82	30		26		15	63		45
IX	40		00	140			85			27		30	62		30
X	36		00	144			87			28		30	61		30
XI	32	43	38	147	16	22	88	38	11	29	19	05	60	40	55
XII	30			150			90			30	00	00	60	00	00

CHAP. X.

How to delineate any Fort *according to the* Proportions *in theſe* Tables.

1. IF you would make a *Square Figure*, a *Pentagon*, *Hexagon*, *Heptagon*, &c. and have not any *Scale* or *Sector* of equal parts, then you may make a *Scale* greater or ſmall, according as you deſign to make the *Polygon*; Divide it into ten equal parts, and every 10th part divide into ten parts, then will the whole *Scale* be divided into 100 equal parts, and by imagining each part ſub-divided into ten parts, ſo will the whole *Scale* be 1000. *Plate* 7. *Fig.* 1.

2. If you would draw a *great Royal*, according to the *Proportions* in the *firſt Table*, then take out of that *Table* the *Semidiameter* or *Radius* of that *Polygon* that you intend to draw, (for *Example*, an *Hexagon*,) which in the *Table* is 62. 39. that is, 62 *Rods*, 3 *Foot*, and 9 *Tenths* of a *Foot*, or 62 *Rods*, and 39 *Centeſmes* of a *Rod*, which take off from the *Scale*, and draw a *Circle*, as 1, 2, 3, 4, 5, 6, as in *Fig.* 2. *Plate* 9.

3. This done, take off the *Scale* the length of the *interior Polygon* 62. 39. or ſide of the *Figure*, which the *Table* ſhews that diſtance, apply it to the *Circumference* 4, 5, 6, 7. 8 or 9 times, as the *Polygon* is that you intend to draw, that is 6 times

in

in the *Hexagon*, draw the blind *Lines* from the *Centre*, and through the ſeveral *Diviſions* 1,2,3,4,5,6. and alſo *Lines* from 1 to 2, and from 2 to 3, and from 3 to 4, and from 4 to 5, and from 5 to 6.

4. Take off from the *Scale* the *Capital Line* 18. 73. as in the *Table*, and ſet it off at all the *Angles* of the Ground-plot, *viz.* from 1 to 2, and from 2 to 3, *&c.*

5 Take the length of the *Gorge* 13. 79. from the *Table* upon your *Scale*, and ſet it off from 1 to 7, and from 2. to 8. and upon the two Points 7 and 7. raiſe *upright* or *perpendicular Lines*, as 7, 8. and 7. 8.

6. Take off from the *Table* the length of the *Flank*, *viz.* 10. 07. upon your *Scale*, and ſet it off from 7 to 8.

7. Draw the *Face* from the uppermoſt part of the *Capital Line d.* to the uttermoſt part of the *Flank* 8. and ſo for the reſt of the *Lines*, they are eaſily ſet off and transferred from theſe, and ſo is your *Draught* finiſhed.

Thus may you by the *Tables*, and a *Scale* of equal parts, eaſily and readily delineate any *Regular Figure* whatſoever two ſeveral ways, according to the *firſt* or *ſecond Table*, for the *Ingenious Artiſt* may uſe which he ſhall find moſt convenient for his purpoſe, ſetting them off by his *Scale* or *Sector*, as hath been taught. And by the *Rule of Three*, theſe *Tables* may ſerve for any *Proportions* whatſoever.

But foraſmuch as theſe *Data's* may be varied without any prejudice to our *Maxims* of *Fortification*,

tion, the *Conſtitution* of the *Ground-lines* will be various, according to the experience and opinions of ſeveral *Engeniers*, I ſhall therefore ſhew the *Conſtitution* and making the principal *Ground-lines* of any *Fortification*, according to the ſeveral ways uſed by other more famous and modern Authors, viz. *Dutch*, *Engliſh*, *Italian*, *French*, &c.

And firſt of the *Dutch* or *German* ways, who, although they have filled the World full of *Books*, and ſeveral ways of *Fortification*, yet *Maralois*, *Fritach*, *Goldman*, and *Dogen* all agree, to make the *Courtain* 36 *Perches*, or 432 *Rhinland Feet*, the *Face* 24 *Perches*, or 288 of the aforeſaid Feet, ſo that the proportion of the *Courtain* to the *Face* is as 3 to 2. the *Angle* forming the *Flank* is always 40 degrees; the *Angle* of the *Bulwark* is half the *Angle* of the *Figure* increaſed with 15 degrees; *Goldman*, *Maralois*, and *Fritach* agree in the *Angle* of the *Bulwark*, but *Dogen* makes the *Angle* of the *Bulwark* equal to $\frac{1}{3}$ of the *Angle* of the *Figure*: ſo that all their *Data's* are very near the ſame with thoſe our *Author* hath before laid down.

As to our *Engliſh* Authors, I ſhall mention only Mr. *Norwood*, who differs very little in his *Maxims* from our *Author*, for indeed the *Dutch Fortification* was then moſt uſed. And Sir *Jonas Moor*, who was indeed an able *Mathematician*, and had great experience in this Art, after he had ſhewed the ſeveral ways of all *modern Enginiers*, tells us, That 'tis moſt agreeable to practiſe the *intericur Polygon* being 1000, to take 333 Feet for the *Capital*, 200 for the *Gorge* and *Flank*, and 600 for the *Courtain*, ſo that he agrees with *Manaſſen Mallet* Author of *Travax de Mars*, And for a gene-

general Rule take, *ſaith he*, $\frac{1}{3}$ of the *interior Polygon* for the *Capital* $\frac{1}{5}$ of it for the *Gorge* and *Flank*, where there is no *ſecond Flank*, and where the *Flank* and *Capital* ſtand at *Right Angles*.

The Emperor *Ferdinand* III. ſets down (as *Schotus* that learned *Jeſuite* tells us,) an univerſal way to lay down the *Lines* of any *Fort*, *viz.* to divide the *interior Polygon* into 22 parts, of theſe take 5 for the *Gorge*, 8 for the *Capital*, and 4 for the *Flank*: Or ſuppoſing the *Polygon* to be divided into 1000, the *Capital* is 363, the *Gorge* 227, the *Flank* 181. this is a good *Proportion*, and for ſuch as are not well skilled in *Trigonometry*, may very well be uſed, Sir *Jo. Moor*.

Of the Italian *Fortifications.*

And firſt of *Signior Pietro Sardi*, who makes the *interior Polygon* 800 *Venetian Feet*, his *Gorges* and *Flanks* 150. and determines the *Face* of the *Baſtion* by the *Line* of *Defence*, razing which in a *Square* or *Pentagon* falls upon the 10th part of the *Courtain*, in an *Hexagon* on the 4th part. In an *Heptagon*, *Octagon*, *Enneagon*, on the 3d part, in all above on the half. To lay this down: Suppoſe an *Hexagon* whoſe *interior Polygon* is 1000, then 187 will be the *Proportion* for the *Gorges* and *Flanks*, which prick off from 4 to 7, and from 5 to 7, and raiſing a *Perpendicular* at 7, ſet off the ſame diſtance from 7 to 8 for the *Flanks*; then for the *Face a. d.* divide the *Courtain* 7, 7, into four parts, and ſet off $\frac{1}{4}$ from 7 to *e.* then lay a Ruler from *e.* to *b.* and draw *a.b.* for the *Face*, but if it had been *Square* or *Pentagon*, then 8 *d.* had been $\frac{1}{10}$ of the

the *Courtain*, if it had been an *Heptagon*, *Octagon*, *Enneagon*, then 8 *d.* had been $\frac{1}{3}$ of the *Courtain*, if above $\frac{1}{3}$ from the oppoſite *Flank*.

2. *Tenſini*, in ſmall Forts above the *Pentagon* makes the *Gorge* and *Flank* equal, and both a 7th part of the *interior Polygon*, and the *Face* in all *Figures* one 3d of the ſaid *Polygon*. To delineate this: Suppoſe an *Hexagon* whoſe *interior Polygon* 5, 6. is divided into 1000. the *Gorge* and *Flank* will be as in the *Table* 143. the 7th part, which ſet off from 5 to 7. and from 6 to 7. and raiſing 7, 8. at *Right Angles*, ſet the ſame diſtance from 7 to 8. then take $\frac{1}{3}$ part of *p. p.* and ſetting one foot of the *Compaſſes* in 8 croſs the *Capital Line* in *d.* and draw 8. *d.* which do to every *Baſtion*, till all be complete.

Of the French *Fortifications.*

The chief of theſe are *M. de la Mont*, and *Manaſſon Mallet*, both theſe divide the *interior Polygon* into five parts, and take one for the *Gorge*, and alſo divide the *interior Polygon* into three parts, and take one for the *Capital Line*; only *De la Mont* takes $\frac{1}{4}$ of the *Courtain* for the *Flank*, and *M. Mallet* makes the *Angle* of the *Flank* and *Courtain* to be 98 degrees, (leaving no *ſecond Flank*,) and ſo lays the *Courtain* more open for uſe, and yet not ſo much as to ſubject it to the ruine of the Beſiegers.

I muſt not forget *D. Ville*, and *Furneirs*, who divide the *interior Polygon* into ſix parts, take one for the *Demigorge* and *Flank*, being both equal, and at *Right Angles*, if the *inferior Polygon* be 1000, the *Gorges* and *Flanks* will be 166.

I ſhall

I ſhall add a ſhort *Table*, by which, and the *Rules* aforeſaid, you may lay down any *Fortification* according to theſe Authors.

	Capital	*Gorge*	*Flank*	*Courtain*
Fritach.	400	220	200	560
Dogen.	351	167	200	666
Emperor.	363	227	181	546
P. Sardi.		187	187	626
Tenſini.		143	143	714
G. Maria.		125	138	750
De la Mont.	333	200	150	600
Maneſſon.	333	200	200	600
Fren. Conqueſt.		200	240	600
Furneir, &c.	228	166	166	666

In this *Table* you have the *Proportions* for the *Capital*, *Gorge*, *Flank*, and *Courtain*, ſuppoſing the length of the *interior Polygon* 1000 *Engliſh* Feet, according to theſe ſeveral Authors. But if the *interior Polygon* be leſs than a 1000, the *Proportions* in this and in the former *Tables* may be reduced to any other *Polygon* required, by multiplying the *length* given by any of thoſe *Numbers*, and cutting off the three laſt places. *Example.* A *Polygon* given is 750, what ſhall be the *length* of the *Capital*, *Gorge*, *Flank*, and *Courtain*, according to any of the aforeſaid Authors. For *Example*, to *De la Mont.* multiply 750 by 333, gives 249 Feet for the *Capital*, ſo for the *Gorge* multiply 750 by 200, and there is 150 for the *Gorge*; then multiply 750 by 150, and there will be 112 for the *Flank*, and after the ſame manner 450 for the

Cour-

Courtain. And thus you may proportion any of these Authors to any *interior Polygon*, which must not exceed 800, nor be less than 500, for if less, your *Fort* will be fit only for *Cittadels* or *Field-works*, but if more than 800 Foot, too big for a *Fort-Royal*, and must be well stored with *great Guns.*

I shall only mention Count *Pagan*'s way which was at one time much approved of here in *England*; he was indeed a great *Mathematician*, and much experienced in many *Campagnes* and *Sieges*, he works by the *exterior Polygon*, and his chief *Proportions* are in the *Table* following.

Exterior Polygon.	1200	1080	1000	960	820	720	600
The half.	600	540	500	480	410	360	300
Length of the Courtain.	425	364	334	304	275	234	164
	212 $\frac{1}{2}$	182	167	152	137 $\frac{1}{2}$	117	82
Length of the Perpendicular.	180	180	180	180	150	144	138
Length of the Face.	364	336	308	288	242	222	200
Complem. of the Line of Defence.	222	192		162	162	162	90

To draw a *Fort* after this way, draw the *exterior Polygon C. D.* divide it into two equal parts at *E.* which suppose 600 each, and raise the *Perpendicular E. L.* upon which set off the length of the *Perpendicular* in the *Table*, *viz.* 180. which will terminate in the *Point F.* then from either *Point D.* and *C.* draw *Lines* to *F.* viz. *C. F.* and *D. F.* then see in the *Table* for the length of the *Face*, *viz.* 364. which set off from *C.* to *I.* and from *D.* to *K.* then (measure out the length of the half *Courtain*, *viz.* 212 $\frac{1}{2}$ from *L.* to *H.* and *G.* or else) take out the Compl. of the *Line* of *Defence*,

viz. 217. and set it off from *F.* to *H.* and from *F.* to *I.* then from *H.* and *I.* and from *G. K.* draw the *Flank.* Thus observing the same method from each *Base* or *exterior Polygon*, you may delineate any *Fortification*; but to fortifie a *Square*, the *Proportions* are to be altered thus:

Base or exterior Polygon	600	550	640	520
Perpendicular	161	146	173	137
Face	364	326	384	296
Compl.	222	211⅓	242⅔	211⅔

And may be delineated by the foregoing *Directions.*

Thus have I set down the several ways for laying down the *fundamental Ground-line* from the most considerable *Engeniers* of this Age, which will better appear by *Plate* 9.

How mechanically to delineate or draw out in the Field any Fortification Regular *or* Irregular, *either from the* exterior *or* interior Polygon, *according to Count* Pagan's *method.*

And first from a Pentagon *to a* strait Line *from the* exterior Polygon.

Divide the given *Base* or *exterior Polygon a. c.* as in *Plate* 9. into two equal parts in the *Point b.* from the *Point b.* erect the *Perpendicular e. b.* of a sufficient length, then divide *a. b.* the half *Base* into 3, 6, or 9 equal parts, and take ⅓ thereof for the *Perpendicular b. d.* so is *d.* a *Point*, through which draw

draw the *Line d. d.* and *d. c.* which done, divide the *Perpendicular b. d.* into 8 equal parts, and make *d. h.* and *d. f.* equal to 9. of thoſe parts, then from the *Points h.* and *f.* let fall the *Perpendiculars h. g.* and *f. p.* till they cut the *Lines a. f.* and *c. b.* in the *Points g.* and *p.* then join the *Points a. g. h.* and *f. p. c.* and ſo have you *a. g.* and *c. p.* for the two *Faces g. h.* and *f. p.* for the two *Flanks*, and *h. f.* for the *Courtain* of the *Fortification*, Plate 9. *Fig.* 3.

From a Square, *to a* Pentagon.

The method of drawing this is the very ſame with the former, only inſtead of dividing the half *Baſe a. c.* into 3, 6, or 9 equal parts, and taking the $\frac{1}{3}$ thereof for the *Perpendicular*, you muſt here divide the half *Baſe a. c.* into 15 or 30 *lengths*, and ſet off 4 or 8 for the *Perpendicular d. b.* and inſtead of dividing the *Perpendicular d. b.* into 8 parts, you are to divide it into 5, and of theſe parts you are to ſet off 7 upon both the *Lines d. f.* and *d. h.* and this is all the difference.

Or note, that having erected your *Perpendicular*, then take any meaſure whatſoever, be it *Pole*, *Staff*, *Line* or *Stake*, and mark out 3, 6, 9, 12, 15, 18, 21, *&c.* upon the *Line a. c.* to the *Point l.* upon which *Point* raiſe a *Perpendicular l. k.* equal to $\frac{1}{3}$ of *a. l.* ſo is *k.* a viſual *Point*, through which is to be drawn the *Line a. f.* cutting the *Perpendicular c. e.* in the *Point d.* and *e.* a viſual *Point*, through which is to be drawn the *Line c. h.* then proceed as be-

fore directed for the *Pentagon:* But for the *Square*, inſtead of marking out 3 *lengths* upon the half *Baſe*, you are here to mark out 15 for the *Line a. l.* and inſtead of $\frac{1}{3}$ you muſt allow 4 of thoſe parts for the *Perpendicular k. l.*

To perform this by the *interior Polygon*, and that from the *Square* and *Pentagon* to a *Right Line*, let the *interior Polygon* given be *A. B.* which divide into 12 parts, then make *d. e.* $\frac{1}{12}$ and *a. i.* $\frac{2}{12}$ for a *Square*, and *a. k.* $\frac{3}{12}$ for a *Pentagon*, *p. k. l.* and *p. i. g. right Angles*, and proceed as before directed, *Plate* IX. *Fig.* 4.

Here note alſo, that the *exterior Polygons* ought to be about 1150 *Feet*, and never leſs than 1024, nor yet more than 1280, that ſo the *Line* of *Defence* may not be too ſhort, or exceed the Port of a *Muſquet-ſhot*, and that the *Angle* of the *Baſtion* be in no caſe whatſoever leſs than 60 degrees; But where either the *Scituation* of a place, or the old *Walls* or *Rampires* of a Town will not admit any ſuch equality either of *Baſes* or *Angles*, then the *Engenier* may either open or ſharpen his *Angles*, or lengthen or ſhorten his *Lines*, as he ſhall find it neceſſary.

Of the Explanation of the Orthographical *Terms.*

Hitherto I have delivered the *Delineations* of *Regular Fortification*, according to the *Ichnographical* part of it; Now I come to the *Orthography*, in which all parts of *Fortification* as to their *Heights* and

Thickneſs

Thickneſs are contained, and firſt of the *Explanation* of *Terms*, as in *Fig.* X. according to the

	Latin.	French.	Engliſh.
B C	*Planta, pes, latitudo Valli Horizontalis.*	*Pied ou le Baſe du Rampart, la Baſſa ou le pied Rampart.*	*The Foot or Baſe of the Rampire, the Horizontal, or Ground-line.*
D F	*Altitudo Valli.*	*Haulteur du Rampart, ou la Largeur du Rampart par, le, haut.*	*The Height of the Rampire.*
B C	*Acclivitas Valli interior.*	*Le penchant, la Montee, interieur du Rampar.*	*The inward ſloop of the Rampire.*
C E	*Acclivitas Valli exterior.*	*La penchant la Montee exterieur.*	*The Outward ſloop of the Rampire.*
B F	*Eriſma Valli interius.*	*La Talus integrieur.*	*The inward Tale.*
G C	*Eriſma Valli exterius.*	*La Talus exterieur.*	*The outward Talu.*
D E	*Latitudo Valli Verticalis.*	*Le Sommet du Rampar, ſon eſpeſſeur au haut.*	*The upper thickneſs of the Rampire.*
D P	*Statio ſive ambulacrum Vallare.*	*La Haute allee ou Terraplein.*	*The Walk or Terraplaine.*
I N O E	*Lorica.*	*Le Parapet.*	*A Breaſt-work.*
I E	*Pes Thoracis, latitudo Loricæ Horizontalis.*	*Baſſe du Parapet, ou le pied.*	*The Baſe of the Parapet, or Breaſt-work.*
O E	*Acclivitas Loricæ exterior.*	*Le penchant exterieur du Parapet.*	*The outward ſloop of the Parapet.*
N I	*Acclivitas Loricæ interior.*	*Le penchant interieur.*	*The inward ſloop of the Parapet.*
E L	*Eriſma Loricæ exterior.*	*Le Talu exteieur du Parapet.*	*The outward Talu.*
I K	*Eriſma Loricæ interior.*	*Le Talu interieure.*	*The inward Talu.*

	Latin.	French.	English.
N O	*Latitudo Verticalis Loricæ.*	*Sonnet du Parapet ; Son espesseur en haut.*	*The Breadth at the Top.*
P H I	*Scabellum, Suppedaneum.*	*La Banquette.*	*A Foot Bank.*
C R	*Stativ, seve ambulacrum promurale.*	*Chemin des Rondes, la Basse allee, ou Fausse braye.*	*The Plane or Walk of the Fausse braye.*
R S T	*Promuralis.*	*La Fausse braye.*	*A Fausse braye, a Counter-wall, or Breastwork.*
T V	*Margo promuralis.*	*La Lisiere, relief, ou Berne.*	*The Foreland or Bankside of the Ditch, the Barm, or Lizier.*
V Y Z X	*Fossa.*	*Le Fosse.*	*The Moat or Ditch.*
I Y	*Fossæ profunditas.*	*Profundeur du Fosse.*	*The depth of the Ditch.*
V Y	*Declivitas Fossæ interior.*	*L'Escarpe.*	*The inward sloap of the Ditch.*
Z X	*Declivitas Fossæ exterior.*	*Contre-escarpe.*	*The outward sloap of the Ditch.*
V I	*Erisma Fossæ interior.*	*Le Talus de l'Escarpe.*	*The inward Talu of the Moat.*
X 3	*Erisma Fossæ exterior.*	*Le Talus de la Contre-escarpe.*	*The outward Talu of the Moat.*
X 4	*Statio Suburbana via Coperta.*	*Le Chemin Covert, Corridor.*	*The Covert way.*
4 5 7 8 6	*Scabellum, & Lorica Viæ tecta.*	*The Banquet, & Parapet du Chemin Covert, l'Esplanade.*	*The Foot-Bank and Breastwork of the Covert way.*
8 6	*Basis. pes Loricæ extimæ, planta Campestris Thoraeis.*	*Pied, ou Base du Parapet de Chemin Covert.*	*The Basis or Ground-line of the Chemin Covert.*
7 8	*Declivitas Loricæ Suburbanæ.*	*Est l'Esplanade, ou vray glacis.*	*Outward sloaping of the Breast-work of the Covert-way.*

Of

Of the Orthographical *Dimenſions and Meaſures of the* Profiles *of* Fortifications.

Of the Rampire. *Plate* X.

Every *Fortification* conſiſts of theſe four Parts:

1. The *Rampire*, with its *Parapets* or *Breaſt-works.*
2. The *Fauſſebray*, or *Counter-breaſt-work.*
3. The *Ditch* or *Moat.*
4. The *Breaſt-work* of the *Covert way*, by the French, *le Glacis.*

The *Rampire* is generally made of *Earth* taken out of the *Ditch* or *Moat*, and heaped up to ſuch a *thickneſs*, that it may be *Cannon-proof.* The *thickneſs* and *height* of the *Rampire* is various, therefore to give *Rules* for the *thickneſs* of the *Works* according to the *nature* of the *Polygon*, is needleſs. The *height D. F.* may not exceed 18 Feet, nor be leſs than 10, but in caſe of *Hills* near the *Fort*, you muſt raiſe *Cavaliers* in your *Bulwarks.*

The *lower thickneſs* of the *Rampire B. C.* may be from 80 to 50 Feet, for all *Royal Forts* generally 70, but indeed according as *Earth* is to be had, therefore we cannot be poſitive in its *Dimenſions.* The *Rampire* muſt be ſo built, that both *without* and *within* it may be *ſloaping*, foraſmuch as a *Rampire* made of *Earth* cannot be built *upright.* The *Sloap* of the inward ſide of the *Rampire B. D.* is commonly a Foot for a Foot, that is, if the *Height D. F.* be 18, the *Talu G. F.* will be 18. if 15, then 15, *&c.* The *outward Sloap C. E.* is generally in proportion half a Foot, for a Foot,

that is, if the *Height G. E.* be 18 or 15, then the *Talu G. C.* will be 9 and $7\frac{1}{2}$, but ſome *Earth* will ſtand better than other, and may ſomtimes require to be lined with *Bruſhwood* and *Fagots*, *Experience* muſt be the Guide.

The *upper thickneſs* of the *Rampire D. E.* is found, if from the *lower* you ſubſtract the *outward* and *inward Talu*, upon which there is always a *Breaſt-work* or *Parapet* built, *viz. i. n. o, e.* whoſe *Dimenſions* are:

1. Its *inward Height*, that is, *I. N.* muſt be 6 Foot, that it may conveniently ſhelter the *Soldiers*.

2. The *outward Height O. L.* muſt be 4 Foot, to give a *Sloap* to defend the *Counterſcarp*, *Ditch*, and the *Field*.

3. The *inward Talu I. K.* will never need to be but 1 Foot, the *outward Talu L. E.* may be always 2 Foot.

4. The *upper thickneſs* of the *Parapet* muſt be *Cannon-proof*, and therefore *alterable*, according to the Nature of the *Soil*, in *light Earth* 20, in *ſtiffer* 16, and in *ſolid rough Clay* 14 Feet.

5. The *lower thickneſs I. E.* is compoſed of the two *Talus's I. K. L. E.* and the *upper thickneſs N. O.*

6. The *Footſtep* or *Banquet*, which is built at the foot of all *Breaſt works*, on the *inſide* is about 3 feet thick or broad, and $7\frac{1}{2}$ high.

7. The *Terraplain* or Walk upon the *Rampire D. P.* is found, if from the *upper thickneſs* of the *Rampire D. E.* you ſubſtract the *lower thickneſs* of the *Breaſt-work I. E.* and the *thickneſs* or *breadth* of the *Step H. I.* there remains *D. P.* for the *Terraplain*.

If

If the *Rampire* wants a *Fauſſebray*, a *Parapet des Rondes*, or *Counter Breaſt-work*, for the defence of the *Moat* or *Wet-ditch*; then there is often left a *Bankſide*, or a *Space of Earth* about 6 Foot broad from the Foot of the *Rampire* to the Brink of the *Ditch*, as *T. V.* which is called the *Foreland Barm* or *Lizier*. Our late *Engeniers* leave out this *Foreland*, and make a Wall of *Stone* or *Brick* from the bottom of the *Moat* to the *Rampire*; or in caſe of neceſſity to make it, the *leſs* the *better*, only enough to ſupport the *Rampire* from ſlipping into the *Ditch*.

Of the Fauſſebray.

The onely end of this *Fauſſebray*, is the defence of the *Moat*, which help a *dry Ditch* doth not ſtand in need of; ſo that thereby a great deal of *Labour* and *Mony* is ſpared, and the making of them being found *inconvenient*, are now altogether left off, and therefore I ſhall only tell you, 'tis repreſented by *R. S. T.* built at the Foot of the *Rampire*, its *height*, and the reſt of its parts are the ſame in all reſpects as that of the *Breaſt-work* of the *Rampire* aforeſaid.

If a *Fauſſebray* be made, then betwixt the *Rampire* and the *Fauſſebray* is left a ſpace *c. v.* fit for the *Beſiegers* to plant and traverſe their *great Guns*, called, *The Walk of the Fauſſebray*, whoſe greateſt *Breadth* is about 24 *Feet*, the leaſt about 12.

Of

Of the Moat *or* Ditch.

The great *Moat* or *Ditch* which ſurrounds the *Fort*, whether *dry* or *wet*, muſt be made *wider* than the *longeſt Trees*, that the *Enemy* may not lay *Bridges* over it, *viz.* from 70 to 100, 130, 140 Feet; and it may be 8, 10 or 12 Foot deep: If it be a dry *Moat*, or not very full with water, then in the middle of the bottom of the *Moat* there is made a *little Ditch* as *large* and as *deep* as the *Work* and *Earth* will give leave; but becauſe the *Earth* that comes out of this *Moat* muſt not much exceed the *ſolidity* of the *Earth* that muſt make up the *Rampire*, *Parapet*, *Fauſſebray*, *Covert way*, and other Works; the true *wideneſs* and *depth* of the *Moat* will then be beſt known, when you have found out the *Solidity* of thoſe, which ſhall be ſhewed in the following *Chapter*, for that ought to be equal to the *aggregate* of the *Works*. The *Covert way* or *Paſſage* between the *outward Sloap* or *Counterſcarp* of the *Moat* and the *Bulwark*, is left about 18 Foot wide more or leſs, as *B.C.* upon which is to be a *Breaſt-work* or *Parapet* of the ſame height, and with the ſame *Foot-bank* that the *Rampire* had on the *inſide*, only this muſt ſo ſloap into the *Campagne*, ſo that a *ſtrait Line* drawn from the top of the *Rampire N.* may terminate the *Sloap* 6, 7, 8.

Prob. I.

To find the Superficial Content *of the* Rampire *and* Parapet, *in the Orthographical* Section *or* Profile, *as alſo of the* Ditch *and* Covert Way.

To find the Superficial *Content* of the *Rampire*,

pire B D E G according to *Bocklern*, *Fig.* 2. *Num. X.* First, add the lower Breadth C. B. 70. to D. E. 46. the upper breadth which makes 116. The half of which is 58. which multiplyed by 16. the depth D. F. gives 928 ſquare Feet, the *Content* of the *Rampire*: Or, foraſmuch as the Earth or ſolidity that lies between theſe two G. E. and D. F. is a *Parallepipidon*, all of one heighth and thickneſs the *Content* is gotten by multiplying the length G. E. or E. D. by 46. by the heigth of the *Rampire* E. G. or D. F. 16, which makes 736 for the ſuperficial *Content* of E. G. D. F. The Earth that lies on either ſide of this Body, and hath each *Talu* for its baſe, and ends at the top of the *Rampire* in a line, *viz.* B. D. F. and G. E. C. are *Priſmees* or half of *Parallepipidons*, and the ſuperficial *Content* is gotten by multiplying the Superficies at the bottom by half the heigth of the *Rampire*.

The ſuperficial *Content* of the *Parapet* I. N. O. E. is found, as the *Rampire*; for if you take the two lengths I. L. 21. and N O. 18, and add them together they make 39, the half of which is 18 ½ or 6 Inches, which multiply by 5 (for the inward height and outward height together is 10, therefore take the mean which is 5) it makes 95, and 5 times 6 is 30 for the Inches, which makes 2 Foot 6 Inches more. In all 97 ½ for the ſuperficial *Content* of the *Parapet*.

To find the ſuperficial Content *of the* Banquet *or* Foot-ſtep, *whoſe breadth is* 3. *and the height* ½, *multiply the breadth by the height* 1 ½ *it makes* 4 ½, *which added to* 97 ½ *makes* 102 *for the whole* Area *of the* Parapet.

To find the ſuperficial Content *of the* Ditch *or* Moat V. Y. X, Z.

You muſt proceed in all reſpects as with the *Rampire*, it being no more than a ſolid reverſed: That is, add the two ſides V. X. 100, and Z. Y. 76 together, which is 176, then take the half 88, which multiply by the depth of the Ditch 3 Z. or 1 Y. which ſuppoſe 12 Foot. The Product 1056 is the *Superficial Content* of the *Ditch* required.

To find the Content *of the* Breaſt-work *beyond the Covert Way* viz. 4. 5. 7. 8. 6.

This Breaſt-work or *Parapet* is always 6 Foot high, and hath about 60 Foot *Talu* to ſloap into the Campagne marked with 6. 7. 8. whoſe length 6. 8. ſhall be 61. the heighth 6. the half 3. the whole *Area* 183.

How

How to find the ſolidity of the Rampire, *and its* Parapet, *with the* Parapet *of the* Covert Way *beyond the* Counterſcarpe, *and thereby to proportion the wideneſs and depth of the* Ditch *or* Moat.

The *Mechanical Rule* generally uſed by Workmen is this: *Take the length of both ſides, and add them together, then take half as a mean, which multiply by the Superficial Content of the Profile, the Product gives the Solidity*, practiſe in *Plate XI.* I meaſure the length of the outſide of the *Rampire* for this 12th part, *viz.* half the *Courtain*, the whole *Flank* and *Face*, which make 634 $\frac{1}{2}$ Feet, the length of the inſide of the *Rampire* ſuppoſe is 596 $\frac{1}{2}$ both added together, makes 1231. the half of which is 615$\frac{1}{2}$. Then, as by *Page* 59, I found 928 for the *Superficial Content* of the *Profile*, now multiply the length 615 $\frac{1}{2}$ by 928, the *Product* will be 571154 ſolid Feet for the *Content* of one 12th part.

Then I meaſure the middle length of the *Parapet*, as I did the outſide of the *Rampire*, which I find to be 628 for $\frac{1}{12}$ of the *Parapet*; and for the *Superficies* of the *Profile*, as by *Prob.* 1. *p.* 59, I found to be 102, which multiplied by the length 628, gives for the *Product* 64046 ſolid Feet.

Then for the *Breaſt-work* beyond the *Covert-way*, by the laſt *Problem* the *Area* was found to be 181 $\frac{1}{2}$ and the length of this *Line* for (by taking the middle of the *Superficies* of the Triangle 7. 8. 6.) becauſe to meaſure the middle length by the former way it would be too long) $\frac{1}{12}$ part of the *Breaſt-work* will be found to be 605$\frac{1}{4}$, which multiplied by 185, the *Area* of the *Profile* makes 111911 ſolid Feet, now adding the *Solidity* of the *Rampire*, and theſe two *Parapets* together.

The Sum of all is 647111 Solid Feet, being the $\frac{1}{12}$ of the whole.

Now

Now to proportion the depth of the *Moat* to this *Solidity*, first measure the length of the middle of the *Moat*, from the middle of the *Courtain* to the *Capital Line*, which you will find by the *Scale* 531, with which divide the *Solidity* 647211 of the *Rampire*, &c. the *Quotient* will be 1218 *superficial Feet* for the *Profile* of the *Moat*, divide 1218 by 100 the upper length of the *Moat*, the *Quotient* is 12 Foot, and more for the depth. Now to know if this will be large enough, you must consider if the Sloap be one Foot in a Foot, then at 12 Foot deep, the top being 100, the bottom of the *Ditch* is 76, the middle 88, which multiplied by 12, the depth maketh 1056, the *Superficial Content*, which multiplied by the length of the middle of the *Moat* 531, gives 560736 which is short of the *Solidity* it should be, therefore widen the *Moat* 10 or 12 Foot more, and make it 112 Foot at the top, and then it gives the *Solidity* required at 12 Foot deep; but if the *Ground* will not suffer to go so deep, then you must widen the *Moat*, so that you may get the aforesaid *Solidity* Here note, that *Ingeniers* allow a 20th part of *Earth* more than the whole *Solidity*: For to want *Earth* the Remedy is very bad, and the *Charge* double; but if there be too much, 'tis no inconvenience, the 20th part of 647211 is 32360, which makes the $\frac{1}{12}$ of the *Rampire* by 679466. And thus much ought you to have for the aforesaid *Solidity*, for you will have occasion for *Batteries*, *Cavaliers*, *Platforms*, and other Works within the *Fort*.

This Estimate being only in solid *Feet*, will want a *Reduction* to an *higher Denomination*.

Note therefore, that a Body of *Earth* or *Stone*

here in *England* 18 Feet each way at *Right Angles*, (that is *Square*) and one Foot deep, is termed a *Floor*, ſo that all our Eſtimates for *Banks* or *Drains* are reckoned by the *Floor*, that is 324 ſolid Feet of *Earth* is a *Floor*, for if you multiply 18 by 18, the *Product* is 324.

If therefore you would know how many *Floors* of *Earth* there are in this, or any other *Work*, divide the former *Solidity* 647111 Feet, by 324, the *Quotient* will be 1997 *Floors* of *Earth* $\frac{1}{4}$ and two Feet; for if the Remainder be 243, it is $\frac{3}{4}$. if 162, it is $\frac{1}{2}$ if $81\frac{1}{2}$ of a *Floor*; and becauſe this is but $\frac{1}{12}$ part of the *Fort*, there would be in the whole 23967 *Floors*, and 24 *Feet*.

There is a *Geometrical* way to find the *Solidity*, which is difficult and tedious, and not much uſed in practice; but ſuch as have a mind to peruſe ſuch large ways, may find them in *Maralois*, *Pitiſcus*, *Dogen*, *Cellarius*, and others.

Some alſo make large *Diſcourſes* about *Directions*, how to build up any *Fort* which any *Workman* or *Maſon* that undertakes the building of *Walls* needs no ſuch helps, beſides the *Circumſtances* are ſo various, the *Prices* ſo uncertain, that no *general Rules* can be given, but the *Ingenier* muſt be ruled by the *Cuſtom of the Country*, which he ought well to underſtand; And 'tis not enough for an *Ingenier* to be expert in the *deſigning part*, and in drawing *Draughts*, for one may lay down more *Forts* in an *Hour*, than all the *Princes in Europe* will build in *Ten Year*: But he muſt alſo know what belongs to the *Mechanical part*, viz. the *Maſons*, *Carpenters*, *Joiners*, *Plumbers Work*; He ought to know the prices of *Timber*, *Lime*, *Stones*, *Sand*, *Brick*, and all

all other *Materials*, that he may complete the Eſtimate of his *Fort*, ſo that he may not be *overſeen*, or *promiſe* or *undertake* what he cannot *perform*, to the damage of his *Prince*, and his own *diſgrace*.

How to order the inner parts *of a* Fortification, *which are the* Streets, Gates, Bridges, *and other* accidental Buildings. *See* Plate *VI.*

1. When a Place, whether *Regular* or *Irregular*, is fixed to be fortified, and accordingly delineated in the *Field*, it is neceſſary that an exact diſtribution and ordering may be made of the *Streets*, *Houſes*, *Gardens*, and *void Places*, where obſerve, that in every *Regular Figure* all the *principal Streets* ſhall be built 20,24,or 30 Foot broad, towards the middle of the *Bulwark* and *Courtain* parallel from the *Centre*,or principal place of the *Fort*.

2. The chiefeſt *Market-place*, which will alſo ſerve for the *Rendezvous-place*, ſhall ſo be ordered in the middle of the *Town* or *City*, that it have the *Figure* of the *Fortification*, and be *parallel* to its *Sides*, that all its *Angles* may anſwer to the *Angles* of the *Bulwarks*. The *Sides* of the *Market-place* are commonly from 9, 10, to 15 *Rods*.

3. The chief Buildings of a *Fortified Place* are the *Churches*, *Market-houſes*, *Armories*, *Magazines*, or *Store-houſes*, a *Work-houſe*, *Corp de Guarde*, *Hoſpital*, *Houſes* for *Soldiers* and *Sentinels*.

4. The *Church* is commonly built not far from the *Market-place*, near it are the *Houſes* for the *Miniſters* and the *Schools*.

5. The *Senate-houſe* ſhall not be far from the *Church*, that its forepart may look towards the *Market-place* ſeparated from all other *Houſes*. There

may likewiſe be built an *Houſe* or *Palace* where the *Prince* or *Governor* of the place may abide in, if there be no *Cittadel*.

6. The *Armories* ſhall be built in the *Streets* near to the *Wall*, that *Arms* and *Guns* may be had ſpeedily; likewiſe the *Houſes* where all ſorts of *Ammunition* are kept, as *Gunpowder*, *Matches*, *Granadoes*, and other *Fireworks* be next to the *Wall*, *ſtrong arched*, *inwardly planted*, and *well ſecured* againſt *Fire* and *Water*.

7. The *Workhouſes* ſhall be near the *Armories*.

8. The *Magazines* ſhall be built on ſeveral *airy* or *lofty parts* of the *Town*, well ſecured againſt all ſorts of damage.

9. The *Corp de Garde* ſhall be upon the *Market-place*, and other ſmall *Guard-houſes* for *Officers* and *Soldiers* ſhall be near the *Gates* or *Bridges*, and may be *broad* from 46 to 64 Feet, 25 Feet *high* from the *Ground* to the *Roof*, provided with a *Chimney*, *Door* and *Windows*, and *large Banks* to lie upon, with other conveniencies belonging to it, are to be placed on the *Baſtions Angle*, and middle of the *Courtain*.

10. The *Watch* or *Sentinels Houſes* ſhall be *round*, or of a *Figure* of 6 or 8 *Angles*, with 3 *Lights* or *Day-holes*, its *height* is commonly 8 Feet, and its *width* 5 or 6 Feet.

11. The *Officers* or *Soldiers* Houſes ſhall be built near the *Wall*.

12. It is likewiſe neceſſary to have *Mills*, and where the *ſituation* will not permit *Water-Mills*, *Wind* or *Horſe-Mills* muſt be built, or they muſt be provided with a good quantity of *Hand-Mills*.

13. The

13. The *common Houſes* for Inhabitants ought to be built of *Brick* or *Stone*, and are commonly 20 or 30 Foot *broad*, 30, 40, 50 Foot *long*.

14. The *Fountains* ſhall be (if it is poſſible) in the *Market-place* and in the *Streets*.

15. The *Ports* or *Gates* are moſt conveniently put in the middle of the *Courtain*, they are of two ſorts: Firſt, *Capital Ports*, which are commonly 10 or 12 Foot *broad*, and 14 or 15 Foot *high*, and are made according to the *thickneſs* and *proportion* of the *Wall*. Secondly, *Little Ports* are made in the middle of the *Courtains*, where they will not place *Capital Ports*, through which they may come to the *Fauſſebray* or *Outworks*, and are therefore called *Sally-Ports*, they are 6 or 7 Foot *broad*, and 7 or 8 Foot *high*, fenced with *double Gates*.

16. The *Bridges* do obſerve the *height* and *breadth* of the *Ports*, they are commonly at a *Capital Port* 12, 14, or 15 Foot *broad*, their *length* is the ſame with the *breadth* of the *Ditch*, they ought to be built of Frames of *Timber*, laid over with ſtrong *Baulkes*, that they may be *thrown down* if occaſion requires.

17. There is commonly in or near the *great Port* a *Wicket* 4 Foot *high*, and half Foot *broad*, which ſerves to *ſally out*.

Of Works *that are uſually made within the* Forts, *viz.* Platforms, Cavaleers *or* Mounts, Cazemates, *&c.* See *Plate* XVIII.

Of Platforms. Theſe are the *Plantations* where the *Guns* are laid, and where *Timber* and *Wood* is reaſonable, they are all made of *Plank*, and *Sleepers*

Joyces to lay them upon; otherwiſe there is a *Platform* made for each *Gun*, which is about 8 Foot wide next the *Porthole*, and 14 at the other ſide, the *length* ought to be 18 Foot at leaſt, the *Portholes* or *Embrazures* in the *Parapet* or *Breaſtwork* for the *Guns*, muſt be about 4 Foot wide towards the *Gun*, and towards the *Enemy* or *Campagne* 8 wider, and 16, 18, or 30 Foot aſunder: But if the *Guns* are to play clear over the *Parapet* without any *Ports*, the *Breaſtwork* muſt be abated to 2 Foot and an half, or 3 Foot *high*, and then they commonly uſe *Cannon Basket* filled with *Earth*, which are removed as there is occaſion.

Cavaleers are a great *Body* or *Quantity* of *Earth* above the *Parapet*, raiſed between the *Gorges* of the *Baſtion*, according to *M Mallet*, whereon to plant *Ordnance*, and *Small Shot*, to hinder the *Enemies Approaches*, and to clear the *Faces*, and diſturb the *Batteries* of the *Enemy*. To make it, do thus upon the *Centre*, make a *Circle* with the diſtance of 80 or 85 Feet, which muſt be filled up of *ſolid Earth* about 20 Foot *high*, which if faced with *Brick* or *Stone*, then the *Talu* ſhall not need to be above a *Yard* and 4 or 6 *Inches*, which will make it in the *Diameter* at the top 160 Foot, upon which you muſt raiſe a *Parapet*, &c. as aforeſaid, in the *Rampire*, and then upon the *Terraplane* at the top, you may plant pieces of *Ordnance*, leaving *Ports* or *Embrazures* in the *Parapet*, and making *Platforms*, as was laſt directed.

Of

Of Cazemates.

Before I give ye the *Meaſures* of my *Cazemates*, I ſhall explain all tne *Parts* of which they are compos'd.

Plate XIII.

A. is the *winding pair of Stairs* to deſcend from the *Rampart* into the firſt *Cazemate*, which is 6 or Foot high above the bottom of the *Moat*; And this is that which I call the *Great Cazemate*.

B. is the *Great Cazemate* ſeen in part by the *Beſiegers*, when they are lodg'd upon the *Level* of their *Parapets* and *Courtains*.

C. is the *Parapet* of that *Cazemate*, 3 or 4 *Fathom thick*, to cover the *Cannon* and the *Cannoneers* from the ſight of the *Counter-Batteries* of the Beſiegers, when they have either *rais'd* or *earth'd* 'em within the *Counterſcarps*.

D. is a part of the *Great Cazemate* wrought farther in, always cover'd and defended by the *great Ear*, and *flanked Angle* of the *oppoſite Baſtion*.

E. is its *Parapet* or *Breaſtwork*, 3 or 4 *Fathom thick*.

F. is the *Magazine* for the *Powder Bullets*, and other *Ammunition* belonging to the *Cazemate*; it muſt be cover'd and hollow'd *inward*, into the ſolid ſubſtance of the *Baſtion*.

G. is the *Pair of Stairs* into the *ſecond Cazemate.*

H. is the *ſecond Cazemate* that lies out of ſight, as being about *two thirds* of it, not to be ſeen by the *Enemy*, though they ſhould come to be lodg'd upon the *Counterſcarps* themſelves.

I. is the *Parapet* of the *blind Cazemate*, 2 or 3 *Fathom thick.*

K. is its *Magazine*, made like the *Magazine* belonging to the former.

L. is the *third Cazemate not ſeen*, and rais'd even with the *Platform* of the *Baſtion.* Upon this may all ſorts of *Artillery* be planted, to ſhoot as well above the *Parapets*, as through the *Holes* that are cut through the *thickneſs* of the *Parapet*, which is from *two* to *three Fathoms.*

M. The *draught* of a *Platform* for the planting of *Cannon*, call'd a *Cavalier*, with its peculiar *Magazine.*

The Structure *or* Manner *of making the* Cazemates, *according to* M. Mallet.

I ſhall not here go about to *entangle* my ſelf in a *vain Diſpute* with thoſe that would have the word *Cazemate* to be derived from the *Spaniſh* words *Caze*, and *mata*, as if we ſhould ſay, *A Houſe of Murder*; And therefore, without more ado, I come to ſhew ye how my own are made.

Suppoſe

Suppoſe the *Baſtions* to be drawn out in *white lines*, that the *Scale* be made *full the length* of one of the ſides of the *Polygon*; and that it be divided into as many equal *Parts* as it contains *Fathoms*, as has been explained at the *beginning* of this Book.

Then extend the *Defence* of the *Baſtion A. B.* from *6* or *7 Fathoms* at moſt, from *B.* to *C.* from the Point *C.* draw *C. D.* parallel to the Flank *B. E.* then divide the Flank *B. E.* into two equal parts, at the Point *F.* to draw from the Point *G.* which is the middle of the oppoſite Front *A. H.* the Line *G. F.* to the inſide of the *Baſtion*, obſerving where it cuts *C. D.* as in *I.* purpoſely to carry on one *Fathom* from *I.* to *L.* afterwards draw the Line *M. L. N.* parallel to *F. I.* the length of which from *M.* to *N.* muſt be 11 *Fathom:* That done, make *N. O.* parallel to the Flank *B. F.* the length of which from *N.* to *O.* muſt be 4 *Fathom.* Laſtly, make *O. P.* parallel to *F. I.* and then all the void ſpace *B. M. N. O. P. C.* ſhall be the Extent of the *Cazemates*, as well of the large *Cazemate*, as of thoſe which are more private.

To make the *Shoulder* or *Ear* of the *Baſtion*, draw upon the Line of Defence *R. S. 6 Fathom* from *E.* to *I.* and upon *F G. 6 Fathom*; alſo from *F.* to *V.* and then joining *V.* and *I.* together, you have the *whole Shoulder* or *Ear F. V. T. E.* which muſt be all one ſolid piece. For the *Parapet* of the firſt *Cazemate*, you muſt allow within ſide 1 *Toiſe* of *height* from 3 to 4 in *thickneſs*, with 8 *firing places* for the planting of ſo many *great Guns*, obſerving that the *Parapets* of the *Cazemates*, more eſpecially all that which is next to the *Gorge*, and

lies

lies always hid from the *Besiegers*, do not require a *length* and *thickness* so precise.

Of the Outworks, *and first of a* Ravelin *or* Target.

A *Ravelin* is a Bulk of Earth almost like a *Bulwark* cut off lying beyond the *Ditch*, for the covering of the *Courtain*, *Bridge*, or *Gate*, and is surrounded with *Water*, and separated from the *Fortification* by the breadth of the *whole Ditch*; it is raised but a little *height* above the level of the *Ground*; towards the *Enemy* 'tis built with a *Rampire* and *Breastwork*, but lies open towards the *Fortification*.

The making of them is Various. Plate *XIV.*

The *Ravelin A.* is thus made, lengthen out the *middle Line* of the *Courtain a. m.* then take with your *Compasses* the length of the *Courtain B. C.* and setting one Foot in *b.* and *c.* describe the *Arch* at *d.* then from the Point *d.* draw black Lines to the *Angles* of the *Flank* and *Face f. e.* where they intersect the *Counterscarpe*, as at *h. g.* shall be the *Faces* of the *Ravelin* from *g.* and *h.* to the intersection of the *Counterscarpe Line* and *Middle Line* of the *Courtain g.* at *i.* draw the *Lines g. l.* and *h. i.* for the *Demigorges*, so is the *Out-ground Line* of the *Ravelin* made. The *upper thickness* of the *Rampire* may be 30 Foot *thick*, and about 6, 7, or 8 Foot *high*, on which there may stand a *Parapet* equal with that on the *Rampire*; And the *Profiles* and *Measures* are made after the same manner as those of the *Rampire*.

The

The *Moat* about the *Ravelin* may be about half the *width* of the *great Moat*, *M. Mallet* makes it half the *Flank* drawn parallel to *g. d. h.* as *l. m. n.* for the *breadth* of the *Moat*.

If you would make the *Ravelin* more *close* and *compact* as *B.* draw the *Lines p. q.* to $\frac{2}{3}$ of the *Flank*, or if more as *c.* then draw the *Line r. s.* to $\frac{1}{2}$ of the *Flank*.

Another way, divide the *Gorge Lines* 2. *b.* and *c.* 3. from which *Points* draw ſtrait *Lines* through the *Flanks*, till they meet one another in the *Point m.* then produce the *marginal Lines* of the *Ditch*, *y. l.* and *z. n.* till they meet in *i.* and cut the former *Lines m. g. h.* ſo ſhall *i. g. d. h.* be the *Ravelin* required.

Of the Halfmoon *or* Helmet. *Plate* XV.

Halfmoons do not differ much from *Ravelins*, they are built before the *Angle* of the *Bulwark*, and are arched in form of a *Creſcent* on that ſide which lies towards the *Bulwark*, and are placed upon the *Covert way* which is beyond the *Ditch*, ſo that their *Capital Line* produced, cuts the *Courtain* into two equal parts.

Let not their *Angle* be leſs than 60 degrees, nor more than 90.

Prolong the *Capital Line B. F.* then upon the *Point B.* and with the diſtance *B. C.* deſcribe the *Arch C. e. d.* then draw out the *Lines* from the *Faces* of the *Baſtion B. I. B. H.* then from the two *Ravelins* deſcribed as before *G. K.* produce the *Lines G. H. S. K. I.* till they meet in the *Point F.* ſo ſhall *H. F.* and *I. F.* be the two *Faces* of the *Halfmoon*.

Ta-

Taquet tells us, 'tis the *weakeſt* of all the *Outworks*, ſeeing it cannot entertain a *good quantity* of *Soldiers* to defend it, by reaſon of its *ſtraits*, and is alſo with more difficulty *defended* from the *Fortification*, therefore there ought to be *Ravelins* built on both ſides; And that they *conſiſt* only of *Faces*, being altogether without *Flank*, otherwiſe being poſſeſſed by the *Enemy*, they cannot be *commanded* from the *Ravelins*, and ſaith 'tis ſtill doubtful whether they are *uſeful* or not, and that the *greateſt uſe* of them is in *Irregular Fortification*.

Of the Tonges *or* Tenailes. *Plate* XVI.

Tenailes are *Outworks* of two ſorts, the firſt having only an *external Angle*, which is called the *ſingle Tenaile*, viz. *R.* the other is called the *double Tenaile*, becauſe it hath two *outward Angles* with one *inward*, viz. *N.*

Theſe are ſeldom made *uſe of*, unleſs when ſome *ſudden occaſion* urges, for the defect of all *external* or *faillant Angles*, is that about the very *Angle* it affords the *Enemy* a certain *Quadrangular ſpace* within, which ſhelters them from the *Shot* of the *Defendants*, therefore ſome *Ingeniers* propoſe it neceſſary to raiſe a *Ravelin* before it; And the *double Tenailes* will likewiſe *double* the *defect*, ſeeing they are made with a *double outward Angle*, therefore are not laid before *Bulwarks*, by reaſon of their *weakneſs*.

But the Author of *Travax de Mars* tells us, That theſe *Tenailes* are very proper to *encloſe* a large ſpace of *Ground* which may annoy the *Town*, or where the *Enemy* may lodge himſelf; And that the

the *double Tenaile* is much more *advantageous*, by reaſon of its *ſaillant* or *outward Angle*, which is much better for *Defence* than the *rentrant* or *inward Angle* of the *ſingle Tenaile*: He alſo allows the *Sides* to be 120 *Toiſes* from the *Faces* of the *Baſtions* to their *Extremities*.

To raiſe or deſcribe the *ſingle Tenaile R.* take the *length* of the *Polygon A. B.* and ſet it off upon the middle of the *Courtain Line* from *c.* to *d.* then upon the *Point d.* draw the *Line E. F.* parallel to the *Courtain*, then prolong the *Flanks* till they interſect that parallel *Line* in *E.* and *F.* ſo have you the *Sides* of the *Tenaile*, which muſt end upon the *Counterſcarps* at *I.* and *L.* then divide *d.* and *e.* into two equal parts, and ſet one off from *d.* to *m.* then joyning *E. m.* and *F. m.* you have made your *ſingle Tenaile*.

To make the *double Tenaile N.* divide *M. E.* and *M. F.* exactly through the *middle* at *o.* and *p.* then take the *half* of *D. m.* and ſet it off to *g.* then join *F. P. Q. O. E.* which ſhall be the *double Tenaile*.

Their *Rampires*, *Parapets*, and *Moats*, together with their *Covert ways* and *Sloapings* are made according to the ſame *meaſures*, and after the ſame manner as thoſe of the *Ravelins* and *Half-moons*.

Of Hornworks. *Plate* XVII.

Theſe are built *oppoſite* to the *Courtain*; if they cover the *whole Courtain*, as ſome will have it, their *Defence* will be from the *Faces* of thoſe *Bulwarks* that the *Courtain* lies between; if it does not cover

cover the *whole Courtain*, as others will have it, the *Defence* of the *Sides* will be greater, *viz.* both from the *Faces* of the *Bulwark*, and from part of the *Courtain*.

To delineate these Works *T. V.* set off the *length* of *A. B.* upon the *middle Line* of the *Courtain* from *C.* to *D.* then at *D.* draw the *Line E. F.* parallel to the *length* of the *Courtain*, then from the *Points E. F.* draw your *Sides* to the *Flanks* of the *Bastions G.* and *H.* which *Sides* shall terminate, where they cut the *Counterscarpe* in *I.* and *L.*

For the *Work* or *Horn* marked *T.* divide *E. F.* into three equal parts, and for the other *Hornwork* marked *V.* divide *E. F.* into four parts, then set off one of these parts from *E.* to *M.* and from *F.* to *N.* and draw the *Line m. n.* which must be divided into three equal parts *m. o. o. p. p. n.* then draw the *Defences F. O.* and *F. P.* and at the *Point O.* raise the *Perpendicular o. q.* or, according to *Mallet*, make it an *Angle* of 98 deg. the *Point* where the *Line O. Q.* cuts the *Defence E. P.* as in *Q.* shall give the *Face E. Q.* and the *Courtain O. P.* then transfer the *Face E. Q.* upon the other *Line* of *Defence* from *F.* to *R.* and the *Flank R. P.*

These *Fortifications* serve to the same *end* as the former, either to *enclose* any piece of *Ground*, or *oppose* any rising or advantageous *commanding place*, and are much more *in use* than the *Tenailes*, *Swallow Tails*, or *Priest Bonnets*, especially being to *secure* any place, the *loss* of which would much *endamage* the Body of the *Garison*. The first of these *Works* is also more in *use* than the second, because the *Flanks* of it are more *large* and *able* to contain a greater number of *Guns*, nevertheless the

the laſt of theſe *Works* is made uſe of in *Cities*, to which the *Wayes* and *Avenues* are not well *diſcovered*, for then they place the *middle* of the *Courtain* in the *High-way*, and many times *ſecure* it with a *ſmall Ravelin*.

How to raiſe the Forts *call'd* Swallows Tails, *and* Prieſts Bonnets. *Plate* XVIII.

The raiſing of theſe *Outworks* differs nothing from that of the preceding *Tenailes:* Therefore to raiſe them, place the *length* of the *Side* of the *Polygon A. B.* upon the *Centre Line* which paſſes through the *middle* of the *Courtain* from *C.* to *D.* and at the *Point D.* draw another *Line* parallel to the *Courtain*, which ſhall terminate from *D.* into *E.* and from *D.* into *F.* through the half of one *Courtain* of the place.

For the *Sides*, draw them through the *middle* of the *Courtain C.* and obſerving that they *cut* the *Counterſcarpe* at *R.* and *S.* they ſhall there *terminate*; ſo that dividing *D.* and *E.* into two equal parts, and ſetting one of theſe parts from *D.* to *M.* upon the *Line* of the middle of the *Courtain*, join after that *M. E.* and *M. F.* and you ſhall have the *Swallow's Tail.*

For the *Prieſt's Bonnet N.* after you have drawn the *Sides*, and made the *re-entring Angle*, as above, you ſhall divide the *Lines M. E.* and *M. F.* exactly in the *middle* at *O.* and *P.* and ſetting off one of its parts from *D.* to *E.* then joining *E. O. Q. P. F.* you ſhall have the *Head* of the *Prieſts Bonnet.* The great *Sides E. T.* and *T. V.* terminate upon the *Counterſcarp* of the *Work*, if there be any belonging to it. Their

Their *Ramparts*, *Parapets*, *Mouſe-ways*, *Moats*, *Covert-ways* and *Slopings* are made as in the *Forts* preceding.

OBSERVATION.

Theſe *Forts* were invented to *encloſe* the *Sources* of *Springs*, *Churches*, *commanding Places*, and the like, which only *extend* in breadth, the *loſs* of which may prove a *great prejudice* to the *Inhabitants*, and annoy the *Defences* of the *Town*. And both theſe and the *preceding Works* are rais'd according as the *Ground* will bear, and not according to any *certain meaſures*, with this farther Remark, *That they ought to be commanded by thoſe Places that are nearest the Body of the Gariſon.*

The Raiſing of Crown-works.

If the *Crown-work* is to be ſet before the *Courtain*, then it is rais'd by prolonging the *Centre Line*, which paſſes through the *middle* of the *Crown*, the *length* at moſt of one ſide and an half of the *Polygon* from *A.* to *B.* then at the *inward* of the entring *Angle* of the *Counterſcarp* C. and at the *Diſtance* C. *B.* make the *Arch* of a *Circle D. B. E.* then place upon it on the each ſide of *B.* the *length* of the *Courtain*, and a *Demigorge* in *F.* and *G.* then draw the *ſtrait Lines F. B.* and *B. G.* from one *Point* to the other, ſo have you the *exterior Polygons* of the *Crown*. Then draw the *Lines*, or great *Sides* of the *Crown* from the *Angles* of the *Flanks K.* and *Z.* belonging to the main *Fortification*, and that ſo as to *terminate* upon the *Counterſcarps* at the

Points

Points H. and *I.* afterwards divide the *Line B. F.* into 3 equal parts, and place one of theſe parts from *B.* to *M.* and from *F.* to *L.* and from *G.* to *N.* upon the *long ſides*, that you may have room to draw the inner *Polygons L. M.* and *M. N.*

To deſign the *Demi-Baſtions*, which have always their *Gorges* equal to their *Capitals*, take *F. L.* and place *L.* in *O.* and *N.* in *P.* upon the inner *Polygons* for the *Gorges.* For the *Demigorge* of the *Baſtions M. X.* and *M. Y.* they are made of the 5th part of *M. L.* then from the *Extremes* of the *Capitals F. B. G.* draw the *Defences*, containing one third of the *Courtain*, *B O. B P.* and *G Y.* and *F. X.* and at the *Point O.* with a *Line* of *Chords* or *Semicircle*, make the *Angle X. O. Q.* of 98 degrees, and mark out where the *Line O. Q.* cuts the *Defence F. X.* in *Q.* to the end you may have *F. Q.* for the *Face*, and *Q. O.* for the *Flank*, and ſo the *Half Baſtion* ſhall be finiſhed, as ſhall the other alſo, *obſerving* the ſame *Rules.*

To make the *Baſtion*, make at the *Point X.* the *Angle* of the *Flank O. X. S.* of 98 degrees, to mark out upon the *Defence B. O.* the *Face B. S.* and *S. X.* ſhall be the *Flank*, as well as *X. O.* the *Courtain*; and ſo continuing the *ſame method* on the other ſide, the *Crown* will be compleated; adding to it the *Ramparts*, *Parapets*, *Moats*, *Covert-ways*, and *Slopings*, as has been directed in the *preceding Pages.*

OBSERVATION.

This *Fortification*, by reaſon of its *largeneſs*, is to be preferr'd before all the *former* by us deſcribed, eſpecially if it be to *encloſe* any *Suburb*, *Convent*, or *Palace* of conſequence; and if any *Road* of the *City* paſſes into the *Crown*, it will be requiſite to raiſe a *Ravelin* before the *Courtain* of the *Crown-work*, as in the *Plate* XIX.

The Raiſing of Crowned Hornworks. *Plate* 20.

The *Horn* being deſign'd, as I have directed *p.* 78. To make the *Crown*, take two thirds *A. B.* of the *breadth* of its *Head A. C.* or its *exterior Polygon*; and from the *Points A.* and *C.* make two *Arches*, which muſt *cut* themſelves in *D.* and from the *Point D.* draw the *Lines D. A.* and *D. C.* which muſt be *divided* into 3 equal parts, and at the firſt *Points* on the ſide of the *Half Baſtions E.* and *F.* draw the two *Lines E. G.* and *F. H.* parallel to the *Faces* of the *Half Baſtions*, which ſhall *terminate* from *E.* into *I.* and from *F.* in *L.* the *length* of *E. D.* and *F. D.* then at the *Point I.* and at the *Diſtance I. E.* draw the *Arch E. M.* which ſhall *terminate* in the opening of the *Compaſſes* from *E.* in *N.* To draw *O. N.* at the *Point N.* draw *N.* 2. below the *Capital* of the *Half Baſtion* to have *N. X.* upon the *Counterſcarp*. The ſame is to be *done* on the other ſide, *that is*, at the *Point L.* as the *Centre* and the *Point* alſo of the *Diſtance L. F.* draw the *Arch H. O.* upon which reſting the other

limb

limb of the *Compaſs* from *F.* to *P.* you may draw the ſide *L. P.* and make *P.* 3. like *N. X.*

For the *Baſtion*, the *Capital D. Q.* is made of the *Half* of *D. E.* and the *Demigorge D. T.* and *D. V.* are made of the third part of *D. E.* ſo that in drawing the *Defences Q. E.* and *Q. F.* and making at the *Point T.* the *Angle E. T. R.* of 98 degrees, the *Interſection* of the *Line T. R.* upon the *Defence Q. E.* at the *Point R.* will produce the *Face Q. R.* and the *Flank R. T.* then tranſport the *Face Q. R.* upon the other *Defence Q. F.* from *Q.* to *S.* and you ſhall have the *Face Q. S.* and the *Flank S. V.* and ſo the *Baſtion* and the *Fort* will be finiſhed, only adding the *Ramparts*, *Parapets*, *Moats*, *Covert-ways*, and *Slopings*, as hereafter directed.

OBSERVATION.

Take notice that this *Crown-work* never ought to be rais'd *very high*, to the end that if it ſhould be *taken* by the *Beſiegers*, they that are *behind* in the *Hornwork* may command it, and *beat off* the *Enemy*, when they *attempt* to lodge *within* it.

Obſerve alſo, that the *breadth* which we have allowed to the *Moats* of the *preceding Forts*, is only upon *ſuppoſition* that the Ground will *permit* it; For we are ſomtimes *conſtrain'd* to alter our *Meaſures* according to the *nature* of the *Places*, which ſomtimes require *larger*, ſomtimes *leſſer Meaſures.*

Of the Raiſing *of* Square Cittadels, *which are built upon the Walls of the City.* Plate XXI.

Where *Cities* are not very well *inhabited*, it is ſufficient to raiſe a *Square Cittadel*, with a Figure proper to contain a *ſmall ſpot* of *Ground*. Frequently this *ſmall Encloſure* depends rather upon the *neceſſity* and *nature* of the *Ground*, than a *voluntary choice* of the *Figure:* So then the number of *Baſtions* being reſolv'd upon, and the *Centre* of the *Cittadel*, which is always to be the *Centre* of a *Baſtion* from the *Centre D.* and the *Diſtance* between *A.* and *B.* which is two *thirds* of *A. C.* the *Courtain* of the *place*, you are to draw the *Circumference E. H. G. F.* which muſt be *divided* into 4 equal *parts*, to make out the firſt *draught* of the 4 *ſides E. H. H. G. G. F.* and *T. E.* the reſt is to be *done* as is directed, *p.* 39 & 40. which ſhews you how to raiſe any *Fort*. The *Baſtions* being made, the *Cittadel* will be finiſh'd; The *Ramparts*, *Parapets*, *Moats*, *Covert-ways*, and *Sloping Parapet* before the *Covert-way*, and may be made as ſhall be directed hereafter.

OBSERVATION.

I deſign'd this *Cittadel*, and the following *Pentagon*, fortifi'd after the *ancient methods*, to the end that they who meet with *Planes*, where they would not *willingly alter* the Form of the *Baſtions*, may be able to build *Cittadels* in thoſe *places* according to my *Maxims*. Note alſo, That the *Flanks* of the *Baſtions* of the *place* which join to the

the *Cittadel* are to be *demoliſhed*, and their *Faces* extended directly with their *Ramparts*, which ought to end inſenſibly *ſloping* at the *Moat* of the *Cittadel*, to the end they may *command* them the more eaſily. The *Cittadels* alſo ought always to be *rais'd higher* than the *City Fortifications*, to the end they may be able to *command* them.

The Raiſing of Cittadels *with five* Baſtions, *which are built upon the Walls of Cities.* Plate XXII.

When *Cities* are well-peopled, and that the *nature* of the *Ground* will ſuffer it, 'tis uſual to lay the *Cittadels* towards the *open Field*, to prevent the ruining of the *Buildings* of the *place*; ſo then after you have *agreed* upon the *number* of *Baſtions*, as here for *Example* upon five to make a *Pentagon.*

Divide one *Courtain* of the City *A. B.* into 4 equal parts, of which *A.C.* comprehends 3. This *Overture* being deſign'd at the *Point* of the *Baſtion D.* draw the *Circumference E. I. H. G. F.* that you may have the 5 *ſides* of the *Polygon E. I. I. H. H. G. G. F.* and *F. E.* putting the *Point E.* directly where the *Circumference* cuts the *Centre Line* of the place, which paſſes through the *Point D.* This will produce two *Baſtions* on the *City ſide*, and three toward the *open Field*, then fortifie this *Pentagon* as is directed *Chap. X.*

This *Cittadel* will be finiſh'd after the *Ramparts*, *Parapets*, *Moats*, *Covert-ways*, and their *ſloping Parapets*

rapets are compleated, as alſo a *Ravelin* juſt before the Gate.

OBSERVATION.

Remember that you are always to *throw down* the *Defences* of the *City* on the *City ſide*, to the end that if the *Inhabitants* ſhould happen to *revolt*, or the *Enemy* to become *Maſters* of it, they may not be able to make *any advantage* of their own *Fortifications*, eſpecially the *Flanks L.* and *M.* which muſt be *ruin'd*, continuing their *Faces* in a *Right Line*, and ſloping down the *Ramparts* to the *Moat* of the *Cittadel*, to the end ſhe may be *able* to command the *whole City*.

Obſerve moreover, That there may be a *great ſpace* between the *Moat* of the *Cittadel*, and the *Houſes* of the *City*; For this *ſpace* is of *great importance* to prevent any *deſigns* which the *Citizens* may have upon the *Cittadel*, as not being able to *approach* undiſcover'd, or *without entrenching* themſelves.

Of Irregular Fortification. Plate XXIII.

Since moſt *Cities* are of an *irregular Figure*, 'tis evident of *what great uſe*, or rather *neceſſity* there is of this part, I ſhall *comprehend* all the matter *briefly*, but *plainly*, in the following *Chapters*.

Firſt, Such *Figures* as have not their *Sides* and *Angles* equal to one another, are called *Irregular*.

Now

Now forasmuch as the *Forms of Towns* are so various, and subject to so many Cases, their *Fortification* cannot be comprehended under certain *Rules*, neither can the Principles of *Regular Fortification* be exactly observed here; It is therefore requisite that the *Engineer* make a *Map* or *Draught* of the whole, with all the *Ways*, *Passages*, *Rivers*, *Pools*, *Enclosures*, and all other *matters* fit to be known, and then consider what *Designs* and *Works* he shall think most *fit* and *proper* for the place. To this end let him know,

1. That the same *Laws* and *Maxims* for *Regular Fortifications* stand and be in force as for the *Irregular*; and that the nearer an *Irregular Figure* comes to a *Regular*, the *stronger* and *better* it is.

2. That none of the *inward Angles* of his *Figure* be less than 90 degrees; if less, then they must be *changed*, by making the *Point* the outward *Point* of a *Bastion*.

3. That the *Angles* of the *Bastion* be not less than 60 degrees.

4. That the *Line of Defence*, or *Side* of an *Irregular Figure*, must not be more than *Musquet-shot*.

5. The *Side* of an *Irregular Figure*, which is too long for two *Bastions*, and too short for three, may be fortified with two great *Bulwarks*.

6. When the *Side* is above 70 *Rod*, there may

be a *Ravelin* erected between the two *Bulwarks*, or a *flat Bulwark* built between.

7. When an *Angle* of the *Figure* is between 80 or 90 degrees, it ought to be *fortified* with a *Hornwork*.

8. All the difference between *Regular* and *Irregular*, consists in the rectifying the *Sides* that are too *short*, or too *long*, and altering the *Angles* that are *too little*, by cutting off from the *length* what is *too much*, or adding to it what is *necessary*, to make them in their *just* and *true Proportions*, as in the *Regular*.

More *Rules* might be given, but there being so *much Variety* in this sort of *Fortification*, the *Engineer* must practise by *himself*, by drawing several *Plats of Irregular Places*, and *fortifie* them. And he should also *peruse* all the *Books* he can get of this *Subject*, as *Marolos*, *Fritach*, *Dogen*, *Dilichius*, *Travax de Mars*, &c. where he will find *Variety of Examples*, which will help to inform his *Fancy*, and rectifie his *Judgment*.

For the Raising the *Ramparts*, *Parapets*, and other *Works*, you must observe the same *Rules*, and proceed in the same *Method* as in the *Regular*, and no otherwise.

And you may also *place* all or any of the *Outworks* (mentioned in the *Regular Fortification*) before the *Courtain*, according to the *Rules* there given, only here a greater *liberty* and *latitude* is left to the *judgment* of a skilful *Artist*, for the raising of the *Outworks* than in the *Regular*; All which you may see by the *Explanation* of the *Terms* in the *following Figure*. Plate *XXIII*.

A. Is

A. is a *Regular Baſtion*, and here I ſhall give one *Rule* to find the *Capital Line* in all *Irregular Angles*, viz. at the end of *each Courtain*, as at *e. d.* croſs an *Arch* at *c.* and *f.* and draw the *Line c.a.* which ſhall be the *Capital Line*, which may be about 240 Feet, a *little more* or *leſs*, and the *Gorges* may be 145, or 150 Feet, or *thereabout*.

B. is a *double Baſtion*, that is, upon the *Plane* of the *great Baſtion*, another *Baſtion* is built upon it *higher:* This hath the uſe of a *Cavaleer*, and overlooks the *Campagne*; there may be about 12 or 18 Feet left between the *Parapet* of the *lower Baſtion*, and the *Foot* of the *higher Baſtion*.

C. is a *Baſtion compoſed*, that is, when the two *interior Polygons* are much unequal, then the *Gorges* will be unequal.

D. is a *Baſtion deformed*, that is, if one of the *interior Polygons* be ſo *ſhort*, that it can have no *Demigorge*.

E. is a *Plat Baſtion*, that is, if the *diſtance* from the Points of the *interior Polygon* be double to the *uſual length*.

F. is a *forked Baſtion*, cut off with a *Tenaile*, that is, if the *Angle* of the *Figure* be leſs than 90 degrees; and becauſe of *Water*, or ſome other *Accident* it cannot be *changed*, then you may cut off the *Angle*, and join it with a *Tenaile*.

G. is

G. is a *Baſtion cut off*, that is, ſeparated from the *Rampire*, ſo that its *Gorges* are in a *Right Line* with the two Points of the *Flanks H. F.*

H. is a *Demi-Baſtion*, that is, ſuch as have their *Gorge* and *Capital* equal, and its *Flank* half of the *Gorge.*

I. is a *Platform* upon an *inward Angle*, for the placing of *great Guns* to ſcour the *Ditch.*

L. is a *Mount upon Piles* for a *Corps du Gard*, with a *Parapet* like that of the *Outworks*, *Cannon-proof*, neceſſary to hinder the *Underſurprizes* when the *Moat* is frozen.

M. is an *indented Line*, often uſed upon the Bank of the *Counterſcarp*, or upon a *River.*

N. is a *Counter-Guard* or *Demi-Baſtion*, built in ſome watry place before the main *Baſtion.*

O. is a *Scillon*, or a *Tenaile* with a *Breaſtwork* placed in the *Moat*, called alſo a *Counter-Guard.*

P. is a *Bonnet*, that is, an advanced *Work* like a *Ravelin*, ſomtimes placed on *high Ground*, ſomtimes on *low*, as in the *Figure* XXIII.

CHAP.

CHAP. XI.

Of laying down upon the Ground *any of the former* Fortifications.

1. YOU muſt have a *Plat* of your *Fort* drawn upon *Paper* very large, ſo that upon each *Line* the *lengths* may be ſet down *Rods* and *Feet*, and the *meaſures* of all the *Angles* particularly expreſſed, as in *Plate* XXIV.

2. Where you extend the *Centre* of your *Fort* as at *A.* there place your *Inſtrument*, whether *plain Table*, *Semicircle*, or *Theodolite*, (if from the *place* all the *Angles* can be ſeen) and from thence ſet out all the *Angles* of the *Centre*, according to the number of the *Sides* of your *Fort* required, which, for *Example*, let it be a *Pentagon*, whoſe *Angles* are alſo 5, and every *Angle* 72 degrees, then fix an *Inſtrument* at *A.* and turning the *Sights* to the beginning of the *Diviſions*, draw out the *Right Line a. b.* as by *Prob.* 1. then turn about the *Sights* 72 degrees, and mark out the *Right Line a. c.* then turn about the *Sights* 72 degrees further, and mark out the *Line a. d.* and ſo for the reſt.

3. Meaſure out the *length* of every one of theſe *Right Lines*, as ſet down in your *Draught*, as with a *Chain* divided and ſubdivided into *Rods* and *Feet*, from

from *A.* to *B.* and from *A.* to *C.* &c. which ſuppoſe to be 68, 52. that is, 68 *Rod*, 5 *Foot*, and 2 *Tenths* of a *Foot*, as in the *Table*, &c. and there ſet *Stakes* at the end of thoſe *Meaſures* which are the *Semidiameters* of the inner *Polygons*, or diſtance from the *Centre*, which being all *ſtaked out*, if you will examine your *Work*, you may meaſure round about from *Stake* to *Stake* the *Sides* of the inner *Polygons*, which by the firſt *Table* is 61. 54. that is, from *B.* to *C.* Then from the *Stake C.* towards the *Stakes* of *B.* and *D.* meaſure the *Gorge Lines C. N.* and *C. P.* which is 13. 26. and ſet a *Stake* at *N.* and *P.* for the end of the *Courtain*, upon which either ſet off a *Right Angle*, (that is, raiſe a *Perpendicular Line*) or elſe an *Angle* greater than a *Right Angle* if required, upon which ſet off the *Flank N. O.* and *P. Q.* 11. 13. meaſure out the *Capital C. G.* 25. 22. upon the *Right Lines* extended beyond *B. C. D.* &c. to *G.* &c. Then draw the *Line G. O.* and *G. Q.* ſo is one *Baſtion* finiſhed, do the like to the reſt *B. F. E. D.* and ſo is your *Fort* lined out for the ſecond *Line*.

But if there be *Houſes* or *Obſtacles* in the way, that from the *Centre* all may not be ſeen, then let *K.* and *G.* repreſent two *Stakes* on the *Ground* where you intend ſhall be the *Heads* or *Angular Points* of your *Bulwarks*. Then placing your *Inſtrument* at *G.* Set off half the *Angle* of the *Polygon K. G. A.* which in this example of a *Pentagon* is 54 degrees. Alſo half the *Angle* of the *Bulwark F. G. C.* which here is 43 degrees, 30 minutes, and in the *Line G. A.* meaſure the *Capital G. C.* ſetting a *Stake* at *C.* for the *Centre* of the *Bulwark*, the

the like you may do from *K.* driving a *Stake* at *B.* the *Centre* of that *Bulwark.* Then placing your *Inſtrument* at *C.* mark a *Line* on the *Ground F. C.* making with the *Line B. C.* an *Angle* of 40 degrees, and where it meets with the *Line G. F.* viz. at *F.* there drive a *Stake* for the ſhoulder of the *Bulwark*, and from *F.* let fall by your *Inſtrument* a *Line* on the Ground *F. N.* perpendicular to the *Line B. C.* The like you may do from *B.* and *L.* And thus have you the *Gorges*, *Flanks* and *Faces*, and *Capital.* In like ſort you may proceed and lay down the other *Sides* of this *Pentagon*, and ſo of any other *Figure.* Sundry other ways might be *preſcribed* for drawing out a *Fort*, but any one that is acquainted with *Geometrical Menſurations* will by practice eaſily find them out.

Note, before you *break Ground*, examine all the parts of your *Deſign* or *Draught* which you have *ſtaked out*, by the beſt *Rules* and *Meaſures* preſcribed, and conſider all *diligently* if time will permit, that ſo if any thing may be *amended*, it may be *done* before you proceed *too far.*

How the Dimenſions *and* Draught *of any* Fort *may be taken and delineated.*

Upon four accounts the *Draught* and *Dimenſions* of a *Fort* already built, ought to be taken and deſcribed.

1. When a *Pattern* is to be taken of a *Fort*, to build another like it.

2. To

2. To find out and know what *Charges* the *Buildings* may come to, and whether it be *built* as it was ordered.

3. To know if the *Fort* have its due Defence.

4. In caſe ſome *New Works* are to be added to it, or the *Old Ones* mended.

There are ſeveral ways for doing this, our *Author* directs,

1. To meaſure the *length* of the *Face* of the *Bulwark* at its Foot outwardly in the *Fauſſebray*, alſo the *length* of the *Flank*, the *Courtain*; and if the *Fortification* be *Regular*, it is not neceſſary to meaſure the other *Bulwarks*, which muſt be done in an *Irregular Fort*, except you would know whether the other *Lines* be exactly of the ſame *length*.

2. The *Angle* of the *Bulwark* muſt be taken, and the *Angle* of the *Shoulder* by your *Inſtrument*, as in the foregoing *Chapter*: Or if in the *inſide*, you may meaſure any *Angle* with your *Chain*, or *Rod-Pole*, by *Prob.* 8. or by the *Table* of *Angles*, which is of very great uſe where *Inſtruments* cannot be gotten, or muſt not be uſed. Thus having theſe *Data's*, you may delineate it on *Paper* by any of the aforeſaid *Rules* and *Directions*, and if you find all the *Lines* exactly to agree, and join one with another all *round about*, until they meet *together* again, you may be ſure that you have taken your *Angles* and *Meaſures* aright.

If

If you would measure the *Profile* with the *Parapet*, you must measure them in the *Ports* or *Gates*, if they be so *built* as to *cut* the Wall in the *middle*; but in case they are not so *built*, you must put your *Quadrant* or *Instrument* upon the uttermost *Point* of the *inward height* of the *Parapet*. And on the other side of the *Ditch*, if it be *Horizontal*, or even ground with the *Bulwark*, let another erect a *long Staff* or *Pole*, on the top of which fasten a *black* or *white* mark, so as that it may *slide* up and down as you please. Then direct your *Eye* towards the *Staff*, until the *mark* comes into your *sight*, which you must give *notice* of by some *certain sign*. Example:

Suppose there were twenty *Foot* from the *Ground* to the *Mark* at the *Staff*, then you may conclude that the *height* of the *Bulwark*, with its *Parapet*, is 20 Foot. Measure likewise the *inward height* of the *Parapet*, with its *Foot-bank*, which is commonly 6 *Foot*, which substract from the 20th, and there is 14 *Foot* for the *height* of the *Rampire*. The *exterior Talu* of the *Rampire* may be easily found by 3 *Staffs*, of which one is placed *upright*, one represents the *Basis*, and the 3d the *Talu*, which form a *Rectangular Triangle*. Then as the *Perpendicular Staff* is to the *Horizontal Staff*, which represents the *Talu*, so is the *height* of the *Wall* to the *Talu*. Example:

If the upright *Staff* be 10 *Parts* or *Feet*, and that which represents the *Talu* be 5, say as 10 to 5. so is 14 the *height* of the *Wall* to 7 Foot *Talu*.

To

To measure the *Wall*, if the *Gate* be built *crooked* or *bending*, so that you cannot *measure* at the *Foot* of the *Wall*, you must measure the *Length* of the *Terraplain* with the *Foot-bank*. And also the *inward Talu*, if it be not the same with the *height* of the *Wall*, the same way as before directed.

Likewise you must measure the *Basis* of the *Parapet*, and having added *them together*, with the *outward Talu* of the *Rampire*, you will have the *exact thickness* of the *Wall*, the *breadth* of the *Ditch*, the *Covert-way*, and the *Counterscarp*, may be easily *measured*, by observing the *precedent Instructions*.

Of the Use of the Table *of* Angles *to a* Base *of* 30 Feet.

When you would measure the *Angle* of any *Field* or *Plot of Ground*, as for *Example*:

Let the *Angle O.K.P.* be measured in *Plate* 26. *Fig.* 2. Take any *Line*, *Staff* or *Stake*, and measure from *K.* to *O.* 30 of them, and from *K.* to *P.* 30. Then at *O.* and *P.* fix up two *Sticks* or *Stakes*, then measure with the same *Staff*, *Stick* or *Line*, the distance between *O.* and *P.* which suppose it be $20\frac{1}{2}$ seek $20\frac{1}{2}$ in the *Table* in the *Column*, over which is the word *Bases*, and the number of the next *Column* answering to it, is the true number of degrees and minutes of the *Angle* sought, *viz.* 40 degrees.

After the same manner, because the distance between *A.O.* is $46\frac{1}{2}$ therefore the *Angle A.K.O.* is 101 degrees, 30 minutes, as will appear by the *Table*.

Sup-

Suppoſe you would lay out an *Angle* of 100 degrees, 5 minutes, firſt ſtick down two *Stakes* or *Sticks* at the *two ends* or *terms* of any *given Line*, as 6 minutes. Then draw a *Line* from *m.* to *k.* and meaſure out 30 equal parts. Then faſtning your *Chain*, *Chord* or *Line* at *K.* equal in *length* to the 30 equal parts. And another *Chain* or *Line* at *m.* look into the *Table of Angles* for 100 degrees, 5 minutes, and you will find 46 to anſwer to it, ſo then cloſe the *two Lines*, and where ever they meet at 30 and 46, as at *B.* thence draw the *Line B. K.* ſo is the *Angle B. K. M.* 100 degrees, 5 minutes, as was required. And after the ſame manner may any *Angle* be laid out moſt *exactly* and *expeditiouſly*, which is of very great uſe where *Inſtruments* cannot be *gotten*, or muſt not be *uſed*.

Of the New Way of Fortifying Places, according to the Sieur Blondel.

This *Author* tells us, That he had made *Fortification* the buſineſs of his *Life*; That he had ſeen all the *Fortified Places* in the *World*; And that he had *diligently* obſerved where their *ſtrength*, and where their *weakneſs* lay; That he had ſerved as *Engineer* in many places as they were *attacqued*, and as they had been *defended*; That he had aſcended from all the *lower*, to all the *higher* Employments in *War*, whereby he has known the difference between *drawing* Lines upon *Paper*, and *marking* them out upon the *Ground*, in the preſence of the *Enemy*; whoſe *Diſcourſe* being very *ingenious* and *brief*, I have tranſlated it into *Engliſh*, as followeth.

In all these Occasions *Experience* has taught me, That the *Art of War* has not found out so many ways to *defend* Towns, as to *attacque* them, which made me make it my *business* for a long time to invent some sort of *Fortification* which should deprive the *Besiegers* of that advantage of *strength* which they have by reason of their great number of *Men*, and great *Guns*, and which should give the *Besieged* space enough to mount more *Artillery*, and an advantage capable to supply the small number of their Men.

But in regard that what I have *thought* upon in this *Particular* is altogether new, I make no *question* but that I shall *draw* upon myself the *Censure* of several persons. And it is also as *true*, that there is nothing more *dangerous*, than to introduce *new Inventions* contrary to the *received Customs*, which is the Reason that I do not here pretend to give any *Advice* as a certain Rule; they are only my *plain thoughts*, which, however, have something of *sure Ground* and *Foundation*, and which may be useful, if examined, without *prejudice*.

But to render them the more *intelligible*, we must look back to the first *Principles* of the *Art*.

The first *Rule* therefore of the *Art* is this, that all the parts of the place ought to be *flank'd*.

The second, that the *Line of Defence* ought not to exceed *Musquet-shot*.

The third, that the *whole Fortification*, and particularly that of the *Flanks* ought to be *strong* enough to resist the *Enemies* Cannon.

From

From these three *Rules* spring the three principal manners of *Fortifying*, called the *Italian*, the *French*, and *Dutch*.

The *Italians*, who were the first that began to erect *Fortifications* at the time when *Breaches* were made with *Cannon-shot*, among other things would have it so, that the Point of their *Bastions* should necessarily contain a *Right Angle*, because they they *thought* their *Bulk* would the better resist the Force of the *Artillery*, and they made their *Demi-gorges*, and their *Flanks* of the 6th part of the inner side of their *Polygon*, and perpendicular to their *Courtain*, contriving *Orillons*, and *high* and *low Places* for the *Defence* of the *Moat*.

The *French*, perceiving that the *Flanks* were easily broken down by the *Batteries*, which the *Enemies* were wont to lodge upon the opposite *Counterscarp*, thought at first it was the best way to secure them, by winding them *across* to the Enemy, and making them *perpendicular* to the *Face* of the Enemy. But understanding the *weakness* of the *oblique Defence*, and that it was not sufficient that a *Flank* should be cover'd, if it did not also itself discover what the Enemy might do in the *Moat*, they presently alter'd that *Contrivance*, and made their *Flanks* perpendicular to the *Courtain*, as the *Italians* did, allowing to the *flank'd Angle* the two thirds of that of the *Polygon*.

The *Hollanders* never heeded whether their *flank'd Angle* were acute or no, provided that it were not so, that the *Point* could not be easily bro-

ken down by the *Cannon-ſhot:* And they made it uſually by adding 15 degrees to the half of the *Angle* of the *Polygon*, and proportioning afterward their *Courtain*, their *Face* and their *Flank*, in ſuch manner that the *Courtain* ſhould be the double of the *Face*, and that the double of the *Flank*. They made it their buſineſs chiefly to allow to their *Face* the moſt that poſſibly they can of the *Flank* in *Courtain*, without *Orillions* or *low Places*, but only a *Fauſſebray*.

This manner of contrivance of ſecond *Flanks* would be very good, if beſides the inconvenience of the *oblique Defence*, the re-entring *Angle* of the *Counterſcarp* did not take away from the *Flank* the ſight of the oppoſite *Face*, when the *Moats* are of a reaſonable breadth. But this defect is ſo ordinary and frequent in *Forts*, the moſt conſiderable which are erected after this manner, that I am ſurpriz'd to find that it has acquir'd ſo great a *Reputation*, in regard it ſeems that the *Flanks* are not built for any uſe, and that the *Faces* are not to be defended but by a *little part* of the *Courtain*.

But though theſe ways have been *invented* and *put* in practice by great Men, and that they have hitherto had the approbation of ſuch as ſtudy the *Defence of Forts*; nevertheleſs the ſmall reſiſtance which the beſt of theſe *Fortifications* have made in the laſt Wars, (and particularly upon the King's march ſome few years ſince into *Flanders*,) has made us believe that the knowledge and skill in *attacquing* was infinitely improv'd above that of *defending* Places, and that ſuppoſing the Courage and Induſtry equal, and all other things proportionable between the *Aſſailants* and *Defendants*, yet the

the condition of the *Beſieger* is much above his that is beſieged.

Monſieur *de Pagan* diſcourſing upon this very Principle, had propos'd a way of *Fortification*, which indeed is infinitely to be preferr'd before the common ways, by making the *Flanks* of a good fair largeneſs perpendicular to the *Line of Defence*, and capable of *three Batteries* one upon another. And the *Model* which appear'd ſome years ſince in *England*, contain'd no more than an eaſie practice of his middle way of *Fortification*.

But, in my Opinion, he has not drawn out the *whole Defence* which the diſpoſition of the place might allow him; And as I am one who is of Opinion, that *Forts* are loſt for want of *Flanks*, whether they be broken down by the *Batteries* of the *Counterſcarps*, or whether they be too ſmall of themſelves, or ſo cloſed up, that they cannot well diſcover the *Faces* of the *Baſtions* which are oppoſed againſt them.

Therefore I thought good to produce a way which extremely augments the *Grandeur* or *Largeneſs* of the *Flanks* and *Demigorges*, ſo as to make ſeveral *Batteries* thereupon, which entirely diſcovers the *Moat*; which deprives the Enemy of the means of making his *Batteries* upon the *Counterſcarp*, which as ſtrongly defends the *Outworks* as the *Moats* of the Body of the Place, and which does not extend the *Line of Defence*.

To this purpoſe I take away a *Right Angle* from that of the *Figure*, and I take the 3d part of the *Remainder*, which I add to 15 degrees to make my diminiſh'd *Angle*, upon which I draw the Sides of

my *Tenaille*, of which I take the half of the one part and the other for the *Faces* of my *Baſtions*. Then having divided the *Exterior Side* into ten equal parts, I take ſeven of them, which I carry back upon the *Sides* of my *Tenaille* to begin at the *Angle* of the *Baſtion* to make my *Lines of Defence*, of which I joyn the *Extremities* by a *Right Line*, which makes my *Courtain*; and from the ſame *Extremities* toward thoſe of the *oppoſite Faces*, I draw the *Lines* of my *Flanks*; And thus my *Tenaille* becomes fortify'd with two *Faces*, two *Flanks*, and a *Courtain*.

By this Contrivance the *Flank'd Angle*, or the *Angle of the Baſtion* in a *Square* is of 60 degrees, of 66 in a *Pentagon*, of 70 in an *Hexagon*; and ſo it augments by little and little in all other *Polygons* to the *Right Line*, where it is of 90 degrees.

The *Flanking Angle*, or the *Angle* of the *Tenaille*, is in the *Square* of 150 degrees, in the *Pentagon* 138. in the *Hexagon* 120. and ſo diminiſhes by little and little in all the other *Polygons* to the *Right Line*, where it is but of 90 degrees.

The diminiſh'd *Angle* is in the *Square* but of 15 degrees, of 21 in a *Pentagon*, of 25 in an *Hexagon*, and it augments by little and little in all the other *Polygons* as far as the *Right Line*, where it is of 45 degrees.

The *Angle* of the *Flank* upon the *Line of Defence* is of 107 degrees, 47 in the *Square*, 100 degrees 41 in a *Pentagon*, 97 degrees 48 in an *Hexagon*, and it diminiſhes by little and little in all the other *Polygons* to the *Right Line*, where it is but of 90 degrees.

The

The *Angle* of the *Flank* upon the *Courtain*, is of 122 degrees, 47 to the *Square*; 123. 11 to the *Pentagon*; 123. 48 to the *Hexagon*: And it augments by little and little in all the other *Polygons* to the *Right Line*, where it is of 135 degrees.

And becauſe I am perſuaded that the *Line of Defence* ought never to be larger than 140 *Toiſe*, nor leſs than 120, in ſuch *Forts* as are called *Royal*, I have for that Reaſon made two Suppoſitions, which I call two Ways; of which the firſt, which is the grand one, makes its *Exterior Side* of 200 *Toiſe* in all *Polygons*, which allows through the whole 140 *Toiſe* for the *Line of Defence*. And the ſecond Way, which is the leſſer, makes throughout the ſame *Exterior Side* of 170 *Toiſe*, which gives little leſs than 120 *Toiſe* for the *Line of Defence*, within which *Limits* I include all that may be fortify'd; for that a longer Extent of the *Exterior Side* renders the *Defence* unprofitable, by reaſon of the too great diſtance of the *Flanks*; and a leſſer Extent diminiſhes the length of the *Flanks*, and augments to no purpoſe the number of *Baſtions*, and the *Expence*.

In the *Great Way*, where the *Line of Defence* is 140 *Toiſe*, and the *Exterior Side* 200.

The *Flank* is to the *Square* 27 *Toiſe*, 36½ to the *Pentagon*; 42½ to the *Hexagon*; and it augments proportionally to the *Right Line*, where it is of 70½.

The *Demigorge* is to the *Square* 28½ *Toiſe*; 35½ to the *Pentagon*; 39 to the *Hexagon*; And it augments proportionally to the *Right Line*, where it is of 70½.

The *Courtain* to the *Square* is of 70½ *Toiſe*, 60½ to the *Pentagon*, and 54 to the *Hexagon*; And it diminiſhes by little and little in all the other *Polygons*, till it come to nothing at the *Right Line*.

In the *Leſſer Way*, where the *Line of Defence* is not above 120 *Toiſe*, and the *Exterior Side* 170,

The *Flank* in a *Square* is 23 *Toiſe*, 31 in a *Pentagon*; 35 in an *Hexagon*; And it augments by little and little in all the other *Polygons*, till you come to the *Right Line*, where it is 60 *Toiſe*.

The *Demigorge* in the *Square* is 24½ *Toiſe*, 29 in the *Pentagon*; 32 in the *Hexagon*; And it augments by little and little in all the other *Polygons* as far as the *Right Line*, where it is of 60 *Toiſe*.

The *Courtain* is to the *Square* 60 *Toiſe*; 52 in the *Pentagon*; 46 in the *Hexagon*; And it diminiſhes by little and little in all the other *Polygons*, until it come to nothing at the *Right Line*.

By which, in the firſt place you may ſee that this Way is not much different from the *Dutch* Way, in reference to the *flanked Angle*, which is the ſame as well in the one as the other to the *Square*, and which differs not in the other *Figures*, only in this, that the enlarging that *Angle* goes a little ſwifter in the *Dutch* Way, where it is ſtrait to the *Dodecagon*, than in this where it is no more than 80 degrees, and does not become right, but at the *Baſtions* upon the *Right Line*. And theſe differences are of ſo ſmall conſequence as to the *ſtrength* or

weak-

weakneſs of the *Point* of the *Baſtion*, that it is not worth the while to make any ſtir about them; But, on the other ſide, they enlarge in ſuch a manner the neceſſary parts of the *Fortification*, that we had juſt cauſe to make uſe of this manner, rather than of any other: Which may be eaſily underſtood by the difference of its *Parts*, which is much larger in the *Flanks* and *Demigorges*, which are the *Parts* that augment the *Defence*, than in the *Faces* which diminiſh it; That of the *Flanks* being 42 *Toiſe* and an half between the *Square* and the *Right Line* in the large manner, and 37 *Toiſe* in the leſſer manner; That of the *Demigorges* of 71 *Toiſe* and an half in the large manner, and 60½ in the leſſer manner; whereas on the contrary the difference of the *Faces* is no more than 19 *Toiſe* in the large manner, and 16 *Toiſe* in the leſſer.

As for what may be objected, That the *acute Angles* of the *Point* of the *Baſtions* diminiſh their Capaciouſneſs, it is of little importance; ſince the difference of the Surface of a *Baſtion* to a *Right Angle*, and of another to an *Angle* of 60 degrees, the *Faces* being equal as well in the one as the other, is no more than an 8th part, which comes inſenſibly to 70 degrees, and ſomwhat more.

My *Flanks* are not quite throughout *perpendicular* to the *Line of Defence*, as in the *Manners* of Monſieur *de Pagan*, for he makes there an *Angle* ſomwhat obtuſe upon the firſt *Polygons*, and the difference of the *Perpendicular* is no more than of 17 degrees, 47 to the *Square*; 10 degrees, 41 to the *Pentagon*; and 7 degrees, 48 to the *Hexagon*, and

and what is above is insensible; so that it is so small a thing, that it gives no considerable *Obliquity* to the *Defence*. However this difference enlarges in such a manner my *Demigorges*, then I find place in the *Square* for three *Batteries*, where I could hardly raise two if the *Angle* were always *Right*.

Here I make use of all the Arguments which Monsieur *de Pagan* brings against those, who fear a too great exposing of the *Flanks* to the *Batteries*, which the *Enemies* raise upon the *Counterscarps*, with this difference only, that he mounts, for the most part, not above 12 or 13 pieces in his *Flanks* to oppose those of the Enemy, when as in certain *Forts* I could oppose against the *Besiegers* in my *Flanks* an hundred or sixscore Pieces, and never less than twenty, or five and twenty in the smallest *Forts*.

My *Demigorges* are large enough for three *Batteries* one above another, one above, a second in the middle, and another below in all the *Polygons*: Nay, in the *Hexagon*, and *Forts* of more *Angles*, there is room enough to raise *Cavaliers* upon the *linings* of the *Flanks*, making use for that purpose of the *Earth* thrown up out of the *Moats*.

I do not take above 8 or 10 *Toise* in the *Flank* at the *Angle* of the *Shoulder*, to serve me for a kind of *Orillion*, and I employ all the rest in the *cover'd Flank* for *Batteries*, or to lodge *Small-shot*; so that I have 18 or 20 *Toise* of *cover'd Flank* in the *Square* for every *Battery*, that is to say, for nine

nine or ten pieces each, and for thirty or two and thirty for the three.

In a *Pentagon*, 26 *Toiſe* of length of *cover'd Flank*, that is to ſay, for 13 or 14 pieces for each *Battery*, and 40 or 45 pieces for the three.

In an *Hexagon*, 32 or 33 *Toiſe* of *Flank cover'd*, that is to ſay, 16 or 17 pieces for each *Battery*, and eight and forty or fifty for the three; beſide 18 pieces for the *Cavalier*, which makes ſixty eight or ſeventy pieces for the defence of each *Flank*.

And ſo in others, enlarging to the *Right Line*, where I have 60 or 61 *Toiſe* of length in *Flank Covert*, which cannot afford room for thirty, or two and thirty pieces in each *Battery*, and above fourſcore and ten pieces for the three, and about an hundred or ſixſcore pieces for the whole *Flank*, comprehending the *Cavalier*.

In a *Pentagon*, or a *Figure* of more *Angles*, I draw back my loweſt *Battery* of the breadth of five or ſix *Toiſe* within the *Demigorge*, to the end it may be the better cover'd by the advance of the *Shoulder*, which ſerves it inſtead of a *ſquare Orillion*. And this drawing back ſerves me to extend my *Courtains* to the *Baſtions* of *Polygons* of ſeveral ſides, and to allow one to thoſe that are upon the *Right Line*, to which I would for the ſame reaſon retire my *Flanks* within ſide, about 10 or 12 *Toiſe* on each ſide, to the end I might have 14 or 15 *Toiſe* of *Courtain*.

My

My inner *Batteries* enlarge themſelves within-ſide, becauſe they are contained between two *Lines*, of which the one is that of the *Defence* extended, and the other runs within-ſide from the point of the *Baſtion* oppos'd, and paſſes through the corner of the *Orillion*, which by that means gives me room for five or ſix pieces, which lie conceal'd under the *Shoulder* of the *Orillion*, which the *Italians* call the *Traytor*, and which cannot be ſeen by the *Counterſcarp*, though they diſcover the whole face of the *Baſtion* oppos'd, and the inſide of the *Breach* that may be made therein. It is alſo impoſſible to diſmount thoſe *Batteries* by *Side-Shots*, by reaſon of the *length* of the *Flank*.

I allow for the Plane of the *Batteries* of the *Flank*, from 9 to 12 Foot of *height* the one above the other; That is to ſay, that the Plane of the loweſt *Battery* ſhall not be above the *Moat* for the *leaſt heighth* above 9 Foot, and for the *higheſt heighth* not exceeding 12. To the *middle Battery*, for the *leaſt height* 18 Foot, and at moſt not above 24. And for the top of the *Rampart* of the *Baſtion*, which is the ſame with the Plane of the uppermoſt *Battery*, not leſs than 27 Foot, nor more than 36. The *Cavalier* ought to be rais'd above the Plane of the *Baſtion* to the ſame *heighth* of from 9 to 12 Foot, not comprehending that of its *Parapet*.

My *Parapets* are 3 *Toiſe* in *breadth*, from 9 to 10 Foot in *heighth* above the loweſt *Batteries*, from 6 to 7 Foot above the *middlemoſt* with *firing holes* both in the one and the other, and 3 Foot and an half

half in reſpect of the other *Batteries*. The *breadth* of the *Platforms* to the *middlemoſt Batteries* and *lowermoſt*, is no more than from 4 to 5 *Toiſes* without the *Parapet*.

The diſpoſal of my *Baſtions* gives me alſo this advantage, that the *oppoſite Faces* ſee one another, and defend one another athwart a *Defence*, thruſting itſelf far in, and which diſcovers the *Back* of the *Breaches*.

I make a *Halfmoon* or *Counterguard* at the point of each *Baſtion*, and parallel to its *Faces* of ſolid *Maſon's-Work* without *Earth*, and countermin'd quite thorough, 3 *Toiſe* and an half, or 4 *Toiſe* broad at moſt, that is to ſay, of 6 or 8 Foot of *Parapet*, and 12 or 15 Foot of *Rampart*.

This *Counterguard* ſerves me principally to deprive the *Counterſcarp* of the ſight of the *Batteries* of the *oppoſed Flank*, and its want of *thickneſs*, is to hinder the *Enemy* from planting his *Cannon* upon it in caſe of forcing it; which is much better, than to make a great *Traverſe* in the *Moat*, by continuing the *Capital Line* of each *Baſtion*, becauſe this does not hinder the liberty of the *Moat*, works the ſame effect as the *Traverſe* for the ſecurity of its *Flanks*, and ſerves of itſelf to defend itſelf.

I raiſe another *Halfmoon* in the midſt of the *Courtain*, which covers entirely the *Shoulders* or *Orillions* of the *Baſtions*. And for the *Defence* of the *Moat*, I take in the *Face* of the *Baſtion* ſo much

much room as may ſee it, where I make a *low Battery* of five or ſix pieces, and another behind that within-ſide about the *height* of the *Parapet* of the *Fort*. The *Plane* of the *low Battery* ſhall be level with that of the *middlemoſt* of the *Flank*, that is to ſay, from 18 to 24 Foot high above the bottom of the *Moat*. And in regard its *Parapet* is 6 or 7 Foot high, the heighth without-ſide ſhall be from 25 to 32 Foot high; which ſuffices to remove all fear, leſt the *Face* of the *Baſtion* ſhould be too much weakned in that part.

This *Halfmoon* ſerves me alſo to defend the *Moat* of the *Counter-guard*, and I take in its *Face* all that can expoſe it to view, where I continue two *Batteries*, the one *above*, the other *below*, in the ſame manner as in that of the *Baſtions*, I allow for *Platform* to this *Halfmoon* no more than is neceſſary for, the *Recoyle* of the *Guns* of the *Batteries*, and I leave the remainder of the *inſide* all void, for the more eaſie making *Countermines* in the *Rampart*, and to take away from the Enemy the means of *lodging* upon it after they have forced it.

In the re-entring *Angles* of the *Counterſcarp* between the *Counterguards* and the *Halfmoon*, I place little *Moons* of a reaſonable of *ſolid Maſons work*, and like to that of the *Counterguards* themſelves; which I do, to prevent the *Flanks* of my *Baſtions* from being ſeen *athwart* any part of the *Field*.

And becauſe it is in this *Moat* that the greateſt

Defence

Defence ought to be made, I make it here the *whole breadth* of my *Flank*, for the lodging the *Counter-guards*, and their *Moat* therein, proportioning the largeneſs both of the one and the other, in ſuch a manner, that there may remain ſufficient for the *great Moat*. And to the end it may be ſeen by all the *Flanks*, I draw *Lines* from the *Angles* of the *Shoulder* to the Point of the *oppoſite Baſtions*, which determine the re-entring *Angles* of my *Half-moons*, ſo that they are no Impediment to the *Defence*.

I alſo make a *Cunett* in my great *Moat*, which I cauſe to run round about of the breadth of from 7 to 8 *Toiſe*, diſtant 5 or 6 *Toiſe* from the *Counterſcarp*, that it may not be eaſie for the Enemy to fill it with the hole of their deſcent into the *Dike*, leaving the reſt at the Foot of the *Moat* for the making of *Retrenchments* and *Lodgings*, and to diſpute the paſſage with the *Enemy*. It alſo ſerves me to guard me from any *Aſſault* that may be fear'd on the ſide of the *low Flanks*, which ſeem to be inacceſſible. And for the more ſecurity, you need no more than continue the *Wall* that ſurrounds the place to the thickneſs of two Foot through the whole *Flank*, and as high as the reſt, and this *Wall* may be beaten down as occaſion requires.

Moreover, I ſee nothing that ſhould hinder me from making another narrower *Cunett* in the *Moats* of the *Outworks*, if they are 10 or 12 *Toiſes* broad, eſpecially in thoſe parts where they have contrived the *low Batteries* in the *Faces* of the *Halfmoons*. I alſo raiſe *Coffres* and *Caponniers* in all the *jutting forth*

forth and *re-entring Angles* of the *Cunetts* to defend the *Faces*, and to be near the *Paſſages* which the *Enemy* may attempt under-ground.

I leave beyond the *Counterſcarp* of the *Works* without a *Coridor* of from 7 to 8 *Toiſe* large cover'd with its *Bankets* and its *Eſplanade*, or *level'd way*, allowing, if you pleaſe, *juttings out without-ſide*, to the re-entring *Angles* of the *Counterſcarp*, for the taking up of *Ground*, and contriving the more ſpacious places of *Arms*.

Thus I do not ſee any part of my *Fortification* which may not be ſeen by at leaſt 3 or 4 others: Nor do I know that hitherto there has been propoſed any other manner which allows ſo much room for the Fire of the *Defence*, and gives ſo many *Impediments* to that of the *Aſſailants*.

Which, in my Opinion, is all that can be deſir'd in a good *Engeneer*, to whom it is not juſt to impute what ſhall fall out *unfortunate* in a *Siege*, through the ignorance or death of the *Commander*, through the ſmall Number or Cowardice of the *Soldiers*, through *Mutiny*, or *Want of Victuals*, or *Ammunition*, or other *Misfortunes*, which are uſually the *Loſs of Places*.

If you think it *fitting* to defend Yourſelf againſt *Mines* and *Blowings up*, make uſe of what Mr. *Pagan* propoſes in his *Baſtions*, which is to allow a little more breadth to the *Faces* of the *Baſtions*, and there to make ſecond *Ramparts* within-ſide ſeparated from the firſt by a *Moat*, which cannot but be a very good way.

I could

I could alſo make it appear, that this *Fortification* might be infinitely augmented by the *Multiplication* of the *Outworks*, and by ſeveral *Advantages* which it is capable to receive within-ſide; That in ſuch places, whoſe *Gorges* are very wide, you may retrench the length of their *Faces* towards the *Shoulders*, and by this means conſiderably extend the *Flanks*, which, upon the *Right Line*, without altering any thing of the other parts, might be enlarg'd to that degree, as to contain above 200 pieces of *Cannon* for the defence of the *Moat* which is oppoſite to them. That this *Fortification* alſo might be applied to all ſorts of *Figures*, *Regular* or *Irregular*. That ſuch Places already fortify'd, according to other ways, might be eaſily reduced to this, without changing the *Faces* of the *Baſtions*, or the *Works* without, provided always that they have a ſecond *Flank*, or a *Courtain*. A thouſand other things could I make appear of this Nature, which I omit, as having propos'd to myſelf in this *Diſcourſe*, to give the *Explication* of my *Way* and *Manner* the moſt *plainly* and *ſuccinctly* that poſſibly I could.

Many Men will be ready to oppoſe againſt this *Invention*, many *Difficulties*, as the Vaſtneſs of the *Expence*, the Number of *Artillery* and *Cannoneers*, the Largeneſs of the *Moats*, the great quantity of *Earth* which is requiſite to be taken out, and the difference between this *Fortification* and all others that have been in uſe: They will alſo object the neceſſity of demoliſhing the *ancient Works*, and many other things of this Nature.

But my deſign is not here to combat theſe contrary Opinions, the Queſtion is only to know,

whether this manner of *Fortification* be better than any of the other? To which if any one ſhall ſay, That it is none of my Invention, let him do me the kindneſs to ſhew me any former Examples. The new *Fortification* of *Mayence* is the only *Fortification* that ſeems to reſemble mine, but when you have diligently examin'd it, you will find them to be two different things.

I have added to this Diſcourſe ſome deſigns, the better to facilitate the underſtanding of what I have ſaid: Of which the firſt Draught is, to teach you the practice upon all ſorts of Angles of *Polygons* given. The ſecond is, to ſhew you how eaſie it is to reduce all places already fortify'd to this method, provided they have a ſecond Flank without any alteration either of the Faces of the *Baſtions*, in the *Moats*, or the Works without. The third is part of four ſeveral *Polygons* fortify'd according to this method, wherein the points of the *Fortification* are exactly ſet down. The laſt is the *Plane* of the City of *Dunkirk*, upon which I have put another according to my method, that by comparing the one with the other, you may the more eaſily apprehend which is the beſt. *Plate* xxvii, xxviii, xxix.

The New Manner of FORTIFICATION, *By the Sieur* Blondel. *Plate* xxviii. *Fig.* 1, 2.

Suppoſe you were to fortifie the *Angle Q. A. B.* of which the *Sides A. Q.* and *A. B.* are equal. From the *Centre A*, at whatſoever diſtance it be, as *A. R.* let the Circle *R. 2. Z.* be drawn, cutting the Sides at *R.* and *Z.* wherein from the Point *R.* draw

R. draw the Right Line *R.* 2. equal to the *Radius* *A.R.* to the end that the *Arch R.* 2. may be of 60 degrees: To the half of which let the *Arch* 2. 4. be made equal, which will be done by the means of 30 degrees, and the entire *Arch R.* 4. of 90 degrees. And then dividing the *Arch* 2. 4. equally into two parts at the Point 3. the *Arch* 3, 4. will be of 15 degrees. Then the *Arch* 4 *Z.* (which is the Remainder of the *Angle* propos'd, from which you have taken one *Right Angle*) may be divided into 3 equal parts at the *Points* 5. and 6. And taking the *Arch* 3, 5. (which is made of the *Arch* 3, 4. of 15 degrees, and the *Arch* 4, 5. which is the 3d part of the *Arch* 4 *Z.* carry it back from the *Points R.* and *Z.* upon the Circumference of the *Circle* to the *Points Y.* and 7. and from the *Points P.* and *O.* to the *Points V.* and *S.* so that every one of the *Arches R.Y. Z.7. P.V. O.S.* may be equal to the *Arch* 3. 5. At length through the Points *Y.* and 7. from the Point *A.* and through *V.* and *S.* from the *Points Q.* and *B.* you must draw the *Right Lines A.Y. X. Q.V.L. A.7.K. B.S.L.* which cutting themselves respectively at the *Points* 8. and *G.* will make the *Tenailles A.* 8. *Q. A.G. B.* every one of the *Sides* of which must be equally cut into two parts, at the *Points N. T. C. D.* which will *terminate* the length of the *Faces* of the *Bastions A.N. Q.T. A.C. B.D.* After which you need no more than divide one of the *Sides* of the *Angle*, as *A. Q.* into two equal parts, and take seven of them as from the Point *Q.* to *R.* which you are to bring back upon the prolong'd *Sides* of the *Tenaille*, as from the *Point Q.* to *F.* from *A.* to *M.* and *F.* and from *B.* to *E.* to have the

length of the Lines of Defence *A. M. A. F. Q. F. B. E.* and laſt of all join the Points *I. M. F. E.* and *I. N. M. T. E. C. F. D.* to have by that means the Right Lines *I. M. F. E.* for *Courtains*. The Right Lines *F. N. M. T. E. C. F. D.* for the Flanks; and the Right Lines *A. C. A. N. Q. T. B. D.* for the Faces of the Baſtions.

How to apply the new manner of Fortification of Places *which have a ſecond Flank, without altering any thing either in the Faces of the* Baſtions, *in the* Moats, *or* Outworks. *Plate* xxviii. *Fig.* 3.

Suppoſe a *Tenaille* fortify'd after the *Dutch* manner, of which the Faces of the Baſtions are *A. C. B. D.* the Flanks *C. F. D. E.* and the Courtain *F. E.* the Counterſcarp *N. O. P.* and the *Halfmoon K. L. O. M.* where the Point *O*, which makes the re-entring Angle of the Counterſcarp, takes away from the Right Flank the ſight of the Face of the Baſtion, which it ought to defend according to the moſt ordinary and worſt way of *Fortification*. To reduce it to the new way, you have no more to do than to continue the Lines of the Faces of the Baſtions beyond the flanking Angle *G.* as *A. C. F.* and *B. D. H.* then from the Point *A.* upon *B. H.* and from the Point *B.* upon *A. F.* to draw the Perpendiculars *C. H. D. F.* which will be the Flanks, and *H. F.* the Courtain of the new *Fortification*; wherein there is nothing alter'd neither as to the *Faces*, the *Moat*, nor the *Outworks*. The Lines of the Points mark out the Detaile of the Parts, as well for the *Batteries* of the *Flanks*, the *Baſtions*, and the *Halfmoons*, as for the *Counterguards* and *Lunettes*.

The

The making of Ramparts, Parapets, Ports and Moats.
Plate XXIV.

The *Rampart* is to be deſign'd upon a piece of Paper, with proper Figures. Take then with your Compaſſes the half of the *Demigorge A. B.* and if you intend to repreſent upon the *Rampart* the *Parapets*, and *Little Banks*, then it is requiſite that you make *B. K.* the length of the *Flank*, to the end you may determine in the inſide of the Figure, the *Rampart* by the Line *F. G.* parallel to the *Polygon A. S.* which is done after this manner:

Place your Ruler upon the ſide of the *Polygon A. S.* and then your Compaſſes being open, with one Leg draw along by the Ruler, and with the other Line mark *F. G.* which is to be the *Rampart*, which being continued quite through the inſide, the Figure will give the *Baſis*, or Breadth requir'd of the Foot of the *Rampart*, which upon the Ground will be from 12 to 15 Fathom.

For the *Parapet I. L.* we take with the Compaſs the 15th part of the *Flank*, to make within ſide of the place a Parallel to the *Faces*, *Flanks*, and *Courtains*. Upon the Ground it will take up in breadth from three to four Fathom.

The *Little Bank* is alſo made within ſide of the Place parallel, and as near as may be to the *Parapet*. The Gates or Ports are mark'd in the middle of the *Courtains*, from about 8 to 10 Feet in Breadth, and a wooden Bridge over the Ditch,

with Gates and Draw-Bridges in ſeveral parts thereof.

For the *Moat*, the Lines being drawn from the Centre, being prolong'd beyond the *Courtains* and the *Baſtions*, we take the breadth of the *Flank C. O.* then from the Point *M.* or flanqued Angle, make the Arch *N.* drawing from *O.* the ſhoulder of the oppoſite *Baſtion*, the Line *O. R.* through the top of the Arch *N.* obſerving that this Line *O. R.* does cut the Capital Line prolong'd to the Point *S.* and the Line which paſſes through the middle of the *Courtain* at the Point *P.* then carry on the diſtance of the middle of the *Courtain T. P.* to the middle of all the other *Courtains* in *V.* the diſtance of the Capital *M. Q.* prolong'd, beyond all the Capitals in *Z.* Then laſtly, join *V. Z.* and ſo you ſhall have the *Moat* and the *Counterſcarp Z. P. S. V.* &c.

OBSERVATION.

The meaſures which I here ſet down, are bigger than they ought to be, to the end you may the better diſcern the *Ramparts*, *Parapets*, *Little Banks* and *Moats*. But when you would mark them out upon the Ground, you may take their juſt meaſures upon the Outlines of the Figure, which will allow, as here, the *Rampart* to be 12 Fathom broad, the *Parapet* 18 Foot, the *Little Bank* three Foot, and the *Moat* 23 Fathom.

This *Section* ſhould have followed in *Page* 69. after *Plate* xi.

CHAP.

CHAP. XII.

The Offenſive Part of Fortification, ſhews how to beſiege and take a fortified Place, and conſiſts chiefly in theſe following Parts. Plate xxxi.

1. IN forming and ordering the Camp and Quarters, alſo in the defence and diviſion of the Camp.

2. In the inward and outward Works of the Camp, which are *Forts*, *Redoubts*, *Stars*, *Trenches*, &c.

3. In the *Batteries*, *Approaches*, *Saps*, *Galleries*, *Mines*, *Breaches*, *Aſſaults*, &c. All which are repreſented in Plate *xxxi.*

A. is the *Profile* or *Senographie* of a Place or Town.
B. is the *Freize* or ſeveral pieces of *Wood* faſtned under the *Parapet.*
C. is the *Ladders* or *Eſcalade.*
D. is the *Breach.*
E. is the *Mine.*
F. is the *Paliſadoes.*
G. is the *Sap.*
H. the *Attaque.*
I. is the *Trenches* of the *Approaches.*
K. is the Line of Communication, *ou Boyaux.*

L. is a *Redoubt* for the Defence and Conſervation of the *Approaches.*
M. is a high *Battery.*
N. is a *Battery* made up of *Earth.*
O. is a *Battery* of *Gabions P.*
Q. is the *Line of Contravallation.*
R. is *Chaus-Traps, Crow-Feet,* or *Calthrops.*
S. Chandileers.
T. Fagots in a *Chandileer.*
V. Gabions.
Y. Corbeiles, or *Baskets of Earth.*
Z. Gallery.

1. A *Fence* made of *Paliſadoes.* 2. *Piles* or *Paliſadoes.* 3. *Horſe de Freeze,* or *Turnpikes.* 4. *Barricade.* 5. *Sauciſſon.* 6. The *Camp.* 7. The *Barraques* for the *Cavallerie.* 8. *Hutts* for the *Infantry.* 9. The *Park* of *Artillery.* 10. The *Tents* for the *Proviſions* and *Stores.* 11. *Place* of the *Arms.* 12. The *Corps de Gard.* 13. The *Quarter* for the *King* or *General.* 14. The *Line* of *Circumvallation.* 15. is an *Eſtoile.* 16. a *Demi-Baſtion.* 17. a *Cemiſe.* 18. a *Redoubt.* 19. a *Vedetter,* or *Horſe Sentinel.* 20. *Mantelets.* 21. *Sacks* of *Earth.*

Of Beſieging Towns.

There are ten Acts proper for a *Siege:* 1. *Blocking up the Town.* 2. *The diſpoſing of the Camp or Quarters.* 3. *Circumvallation and Contravallation.* 4. *The opening of the Trenches.* 5. *The carrying on of the Lines of Approaches.* 6. *The Batteries for great Guns.* 7. *The Line of Communication.* 8. *The Sap.* 9. *The Gallery. And* 10. *the Mine.* All which I ſhall briefly, but diſtinctly explain. 1. *Block-*

1. *Blocking up a Town*, is when the *Beſiegers* take care to ſtop all ways and paſſages, and all Intelligence that may be ſent into or out of the *Town* or *Fort* that is attacked.

Of the Camp *and* Quarters.

2. As ſoon as the place is blocked up, and all the *Army*, *Baggage*, *Proviſions of War*, and the *Artillery* are arrived, then the *Camp* is formed out. And here is to be well conſidered the condition and ſituation of the place, how the *Quarters* as well for the *Cavalry* as *Infantry* may be diſtributed, and how beſt ſecured with ſufficient *Trenches*, *Batteries*, *Redoubts*, and other Works neceſſary; more particularly muſt be conſidered theſe Circumſtances.

1. *Hills* and other high places near a *Camp*, which muſt be ſecured by ſtrong works, or by a detachment of *Soldiers*, or elſe altogether avoided.

2. The *Camp* muſt be above *Cannon-ſhot* from the Town, that ſo the Enemies Guns may do it no damage.

3. If the *Camp* muſt be formed in a low place, great care muſt be taken, and it muſt be well viewed, whether it may not be overflowed and drowned.

4. If it happens that the *Camp* muſt be near a *Wood*, then the *Wood* muſt be included in the *Trenches*, or elſe deſtroyed and burnt up.

5. That if the place ſtands upon a *River*, there muſt be a detachement made of one part of the Army to take its Quarters on the other ſide with Bridges of *Communication* well fortified.

6. That

6. That all *Ports* and *Paſſages* which lead to or from the *Camp*, muſt be well fortified, and ſufficiently ſecured and guarded.

Of the Lines of Contravallation and Circumvallation.
Plate xxxiii.

After the *Camp* is formed, the next thing is to chuſe a fit place to begin the *Line of Contravallation*, called, *Breaking of Ground*, which is to be choſen beyond *Muſquet* or *Falcon-ſhot* from the Town. This *Line*, if the Gariſon be ſtrong, and well ſtored with Men, is carried round about the Town to keep them in, and hinder the Sallies from hurting the *Beſiegers*; And if the Enemy have Armies near that may endeavor to raiſe the Siege before the Town can be taken, then there muſt be made another Line further into the *Campagne*, which is called, *The Line of Circumvallation*. The better to perform this, the *Ingineers* ſhall go round the place, and well obſerve the Ground by which they are to draw the Line, taking a Draught of the circumjacent Ground, obſerving all the *Hills*, *Heights*, *Vallies*, *Rivers*, *Churches*, and whatſoever may ſerve for Lodgings as well for *Horſe* as *Foot*, or whatſoever may ſerve for places of *Covert*. The *Ingineers* having preſented the Draught to the General, and having concluded which way the *Line of Circumvallation* is to be made, it muſt be marked out with *Piquets* and *Chords*. The Breadth about 10 or 12 Foot, and 4, 5, or 6 Foot deep. Upon this Line, within Muſquet-ſhot, or 750 Foot one from another, are to be placed *Redoubts*, *Long Squares*, with *Tenailles*, *Triangles*, *Ravelins*, *Half-Moons*, *Half-Baſtions*, *Star-Works*, *Field-Skonces*, and other Forts

Forts with *Ramparts*, whoſe *Baſis* may be ſome 8 or 10 Foot thick. The interior height of the *Parapet* 6 Foot, the exterior 5 Foot. The *Banquet* 3 Foot broad, and 1½ high. Theſe Works indeed are various, and are made according to the Circumſtances of the Place, the Strength of the Enemy, and Danger of the Army.

This *Line of Circumvallation* is to be carried round the *Camp*, encloſing Ground enough for all the *Army* to lodge in; And the *Quarters* of the General, and other great Commanders, are to be placed round about, ſo as they may conveniently relieve each other. And theſe *Lines of Contravallation and Circumvallation*, with their ſeveral aforeſaid Works, being, by the *Ingineer* deſigned and marked out in fit diſtances, every Regiment ſhall work at them in their reſpective Quarters.

Of opening the Trenches.

The place for opening of the *Trenches*, that is, the beginning of the *Lines of Approaches* appointed out, which may be about 1000 or 12000 Foot from the Town. There ought firſt to be built a *Redoubt* or *Battery* of Guns well flanked and defended, to keep or divert the *Enemy* from firing into the *Trenches*, which Line is carried on obliquely, ſo that no *Shot* can be made out of any work of the Town that may ſcour the *Trenches*, with 3 or 4 Turnings you may approach to the *Counterſcarp*, *Bank* or *Glacis*, at the end of each Turning there muſt be a *Redoubt* built for *Guards*, the width of theſe *Trenches* may be 12 or 14 Foot at the

the top, the depth 4 Foot, ſo that the *Depth* and *Bank* made of the *Earth* thrown out, may be a good and ſafe *Covert* for the Soldiers, and may be 6 or 8 Foot at the bottom, with 2 or 3 Steps to get up to the *Breaſtwork*, but deeper and wider as you come nearer to the Town: But if the Ground be *Rocky* or *Marſhy* with Bogs, then there muſt be provided abundance of *Hurdles*, *Babions*, or *Cannon Baskets* and *Bavins*, to make great *Eſpaulments* well flanked, to cover the *Soldiers* from the Enemies Cannon. The *Regiments* which are to open the *Trenches*, and beat back the *Sallies* of the Enemies, make their *Detachements* before they draw out of their *Camps*, and provide the number of *Labourers* that the *Ingineers* have requir'd, with *Officers* to lead them. As ſoon as the day ends, the *Soldiers* commanded to work begin to dig and caſt up *Earth*, and others bring *Fagots* and other Neceſſaries; and thoſe that are appointed for Defence of the *Works*, lay themſelves on their *Bellies* ſome paces beyond the *Counterſcarp*, and as ſoon as Day breaks, that Officer commands all to draw back into the *Trenches*.

Of the carrying on the Lines of Approaches *and* Batteries.

1. The *Ingineers* muſt be ſure to be provided with *Piles* or *Paliſadoes* made of Wood, about 3 Inches, or little leſs, in *Diameter* 5 or 6 Foot high, wrought round, plated or ſhod with *Iron* at the *Points*, and having 2 or 3 great *Iron Nails* driven through them towards the *Head* 8 or 9 Inches long, as *Fig.* I. M. N. *Plate* xxxi.

2. With

2. With *Turn-pikes*, or *Spars* of 12 or 14 Foot long, and about 6 Inches *Diameter*, having 6 Sides bored with Holes one right under another, on each ſide about 6 Inches diſtant one from the other; the *Pickets* that are driven into the Holes are 5 or 6 Foot long, pointed with *Iron* at both ends, and well faſtned into the Holes. Theſe are of great uſe to ſtop the Enemy in the *Breaches*.

3. *Barricadoes*, that is, a *Fence* made of *Paliſadoes*.

4. *Candileers*, that is, a *Frame* to lay *Fagots* or *Long Bruſhwood* in.

5. *Mantelets*, or *Blinds* made of *Boards* or *Long Planks*, and filled with *Earth* 4 or 5 Foot high, 1 Foot and an half thick, 1, 2, or 3 Rod long, which are moveable for to ſhelter the *Muſqueteers* and the *Workmen*.

6. *Gabions*, or *Cannon-Baskets*, which ought to be 3 or 4 Foot *diameter*, and 5 or 6 Foot high, filled with *Earth* well rammed down.

7. *Crow-Feet*, *Chaus-Traps*, or *Calthrops*, which are four pointed *Irons*, one Point always upwards.

8. *Muſket-Baskets*, or *ſmaller Gabions* about a Foot and an half high, 8 or 10 Inches at the bottom, and a Foot at the top *diameter*, and are uſually placed upon *Low Breaſtworks*, or when the *Great Work* is beaten down.

9. *Canvas Bags of Earth* about a Foot in *diameter*, and a Foot and half in *length*, to be laid upon the *Parapets*, or on the edges of *Retrenchments*.

10. *Beetles*

10. *Beetles* of all ſorts, to drive *Piles* or *Paliſadoes* with into the Ground.

11. *Gins* and *Drugs* for lifting up and ſhifting *Guns*.

12. *Shovels*, *Spades*, *Pickaxes*, *Wheel-Barrows*, *Hand-Barrows*, *Rammers*.

13. *Mortar-pieces*, great and leſſer, with *Granadoe-ſhells*, and all Materials belonging to them. *Hand-Granadoes* fitted with *Fuzes*.

Of the Line of Communication.

When the *Trenches* are brought to the Foot of the *Counterſcarp Bank*, then there ought to be made a *Line of Communication* betwixt the two or more *Approaches* that were carried on at one time. This *Trench* is to be filled with *Muſqueteers*, who are continually day and night to hinder the Enemy from ſhewing their Heads above the *Rampire*, while the *Cannons* are beating down the *Parapets*, and levelling the *Works*.

Of the Line called the Sapp.

This is a deep *Trench* or long *Chanel* directed to that part of the *Fortification* which is deſigned for the *Mine*, which is commonly one of the Faces of the *Bulwark*.

When you can no longer draw your *Trenches* obliquely, there is cut a ſtrait deep *Trench*, or long *Chanel* called the *Sapp*, through the *Out-Breaſt-work* directly to that part of the *Fortification* which is deſigned for the *Mine* and *Attack*, which is com-

commonly at the end of the Faces of the *Bulwark*.

This *Chanel* or *Trench* is made deeper than the reſt of the *Approaches*, and is covered above with *Boughs*, *Hydes*, or other neceſſary matter, to keep the *Pioneers* from the ſight of the *Beſiegers*.

Of the filling up of the Ditch, *and carrying over the* Gallery.

The *Sapp* being advanced through the *Out-Breaſt-work* and *Covert-way* unto the *Moat*, then great ſtore of *Pioneers* muſt be employed to carry *Earth*, *Fagots*, *Stones*, &c. in *Wheelbarrows*, or otherwiſe night and day to fill up the *Moat*.

The *Mount* is to be raiſed on that ſide which reſpects the Enemies *Courtain* and *oppoſite Flank*, and ſo to be wrought and carried on with ſuch a breadth, that the *Gallery* may be conveniently ſet upon it, the upper part of which muſt be well fortified againſt *Fire*, by being covered with a Foot and an half of *Earth*. Theſe *Galleries* are made of *Frames of Timber* ſome 8 or 10 Feet wide, and the height 9 Foot. And that ſide reſpecting the *Enemies Flank* muſt be double planked, or *Chandeleers* and *Fagots* may be planted to ſave the *Pioneers*.

Theſe *Frames* are to ſtand 6 or 7 Foot one from another, till the *Galleries* reach to the Foot of the *Bulwark*. In the univerſal affair of a *Siege*, there is not any *Enterprize* more dangerous than this.

Of

Of the Mine.

The *Gallery* being brought over to the Face of the *Enemies Bulwark*, the next is to make a *Mine*, which is done by *Miners* with Inſtruments fit for that purpoſe, and is generally made four Foot, or three and an half high and wide, but narrower the nearer you come to the place appointed. The *Chanel* is made winding by ſeveral turns wrought on to prevent the ſtrength of the *Powder* from coming out *forwards*, when the *Miner* is come to the place deſigned, which ought to be further than the outward *Talu*. Then he makes the place for the *Powder*, which is about 8 or 10 Foot wide, and 4 or 5 Foot high. Here he puts the *Barrels of Powder*, which muſt not be long there before the time of execution, leſt it grow moiſt and be ſpoiled. The Mouth of the *Mine* muſt be cloſe ſtopped, putting *croſs Timbers* in each Return, leaving a *Trunk* or *hollow Pipe* full of *Powder* for the *Train*, ſo that putting a *Match* to it, the *Mine* may be blowed up at the time appointed.

Of a Storm, *or* General Aſſault. *Plate* xxxiii.

Proceeding to a *General Aſſault*, the *General* gives Order for the *Breaches* to be viewed by ſome Perſon of great *Knowledge* and *Experience*, ſuch are the *Majors* and *Engineers*; and the Perſon ſent is generally armed *Cap-a-pe*, Muſquet-proof, and attended by a *Guard of Muſqueteers*. He obſerves the nature of the *Breach*, whether *wide enough*, whether *eaſie or difficult of Aſcent*, and how *annoy'd* and

and defended by the Enemies either *Flanking*, or oppos'd againſt thoſe that ſhall enter, and what *Annoyances* or *Defences* of the Enemy may be removed by new *Batteries*.

And now the *Storm* being reſolv'd upon, when every thing is in a *readineſs*, the beſt time to mount the *Breach* is in the day-time, when every one deſires, out of a *Noble Emulation*, to do his utmoſt; and *Cowards* are oblig'd to make a *Figure*, as having no way to hide themſelves, which they might do in the Night: Beſides, that the *Beſiegers Artillery* plays more exactly upon the *Defences* of the place, and upon the *Head* of the *Breaches*, than they could do in the Night: Beſides, that they who are commanded to enter the *Breach*, would be in danger in the dark of being kill'd by their *own Shot*.

Now as the *firſt Onſet* is an Honour coveted by Men of *daring Spirits*; there are many who claim it as their *Right* to be the *firſt*, though indeed the *Advantage* belongs to thoſe who that day had the *Guard* of the *Trenches*.

However, the *Signal* being given by a *Bomb*, or ſome other *luminous Ball* ſhot up in the *Air*, every one muſt go to the *Aſſault* according to his *Quality*, and the *Orders* he has received. Now in regard it is of high *Concernment* to give the *Beſieged* ſeveral *Diverſions* at the ſame time, and to *diſturb* 'em in their *Defences*, beſides the *two Breaches*, which are the leaſt *Number* that can be made in order to a *general Aſſault*, the General therefore hotly *alarms*, and *threatens* ſeveral other places with the *Scalado* at the ſame Inſtant.

The *first* that go to the *Assault* must be about 40, commanded by a *Lieutenant*, or an *Ensign*, and *two Serjeants*. They must be arm'd *Musket*, or at least *Pistol-proof*; the one half carry *Blunderbusses*, *Pistols*, *Halberds*, and other *short Weapons*; the t'other *Half-Pikes*, *Mantlets*, and *Bavins*, to make good their *Ground*.

Those that follow the *first* must be *more* in Number, who must themselves *be backt* with a more numerous *Supply*, every one making it their business to *relieve* and *reinforce* one another, till they have *lodg'd* themselves upon the *Head* of the *Breach*.

Concerning *Mines*, I may add thus much more, without prejudice to the *Art*, That the *chiefest things* to be respected are these:

1. The *true distance* to a designed place.
2. The *direction of a Mine*, that you may not err in your course.
3. The *strengthning of the Mine* with Timber-work; the *well stopping* of it; and the *well laying* of the Train.

Lastly, The *Countermining* and *Crossmeeting*; all which *Parts* have very many *Circumstances* very considerable, and require a *larger Discourse* than can be afforded in this place; only thus much, that *Mines* are much better than *Batteries*, where you can *come* to make use of them with any *Expedition*; because of their *sudden* and *unexpected Operations*.

Thus have I briefly given plain and easie *Rules* for all *Modern Fortifications*.

Of

Of Gunnery.

FOraſmuch as the *Secrets* of the *Art of Gunnery* are numerous, and that thoſe *Myſteries* are publiſhed and ſet forth by others of *great and able Skill and Science therein*, eſpecially by my *ingenious Friend* Mr. *Robert Anderſon*, in his late *genuine Uſe* and *Effects* of the *Gun*, as well *Experimentally* as *Mathematically* demonſtrated, with *Tables of Projection*, &c. exactly *Calculated*, and their *Uſes Exemplified*:

Wherein he hath *laid down* 50 *Propoſitions* concerning *Practical Gunnery*, by which you may,

1. From any *Shot of a Piece*, however made, find the *greateſt Random*.

2. The *Complication* and *Relation* of all *Guns* of the ſame *kind* amongſt themſelves; and hence the *Dimenſions* and the *Requiſites* of *Powder* of any *Piece*, a *Rang* anſwering to any *Degree* being given; to find the *Requiſite* of *Powder* of any other *Piece*, and to *ſtrike* any place, *at demand*, within its *reach*, its *Dimenſions* alſo being given.

3. The *Nature*, *Property* and *Uſe* of *Mortar-Pieces*, with their *Complications* and *Relations*.

4. Alſo the *ſhooting of Granadoes* out of *long Guns*, with their *manifold Uſes*, &c.

By which *new Art* and *Method* of *Shooting*, he tells us a *Cannoneer* may do *ſtrange Execution* on an *Enemy* at a far *greater diſtance* than is ſet down by other *Authors*.

By

By this, from a *Caſtle* or *Fort*, taking the *Diſtances* at leiſure of all ſuch places by which an *Enemy* may approach, the *Enemy* may receive ſo much *detriment*, that it will be impoſſible for him to be Maſter of that *Fort* or *Caſtle* by *Storm*.

By this, may an *Army* be extremely *annoyed*, although at 4, 6, or 8 *Miles* diſtance.

By this, a *Fire-Maſter* may lay his *Granado* or *Fire-Ball* at any place, *at demand*, and give its *Fuſee* its juſt time.

By this, the *General* of an *Army* may ſpeedily *win the Field*; perform *unexpected Batteries* at *great Diſtances*; and *deſtroy* many of his *Enemies*, before they *think themſelves* within the *reach* and *danger* of his *Artillery*.

The *like Service* may be done *upon Ships at Sea*, at *great Diſtances*, though there the *Direction* of a *Piece* is always *leſs certain* than at *Land*.

By this a *Gun-Founder* may caſt *Guns*, *according to demand*, either for *Rang*, *Force*, or *Time*, with many other *ſtrange Things* in this *Art*.

I ſhall therefore omit to write any thing more, relating to that *Art*; but commend him, that would be an *ingenious Artiſt*, to the peruſal of that Book, a Work of *ſingular Uſe* unto *Generals* of *Armies*, *Engineers*, and other *Artiſts*. Sold by *Robert Morden* at the *Atlas* in *Cornhil* near the *Royal Exchange*, London.

THE

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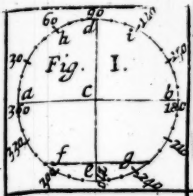
FINIS.

Plate 1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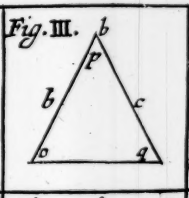
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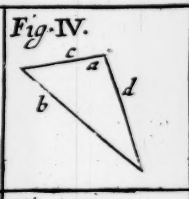
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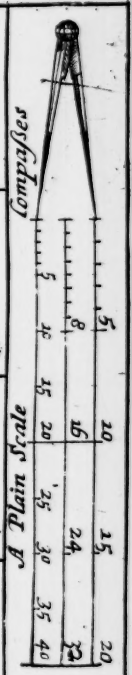
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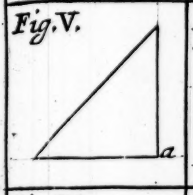
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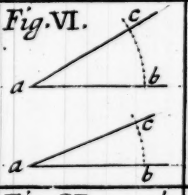
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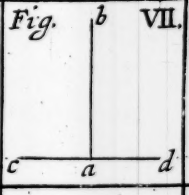
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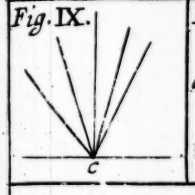
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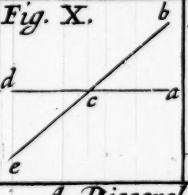
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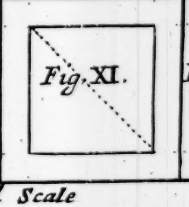
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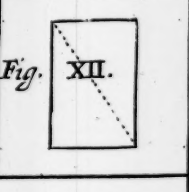
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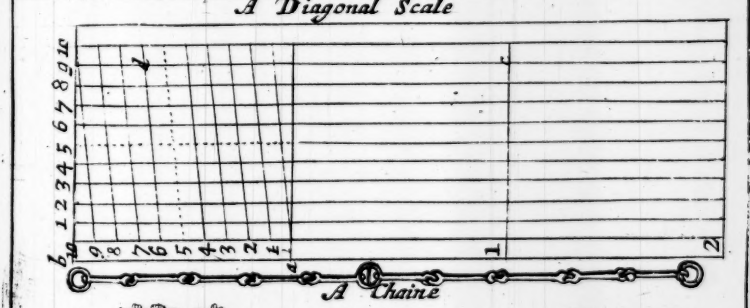
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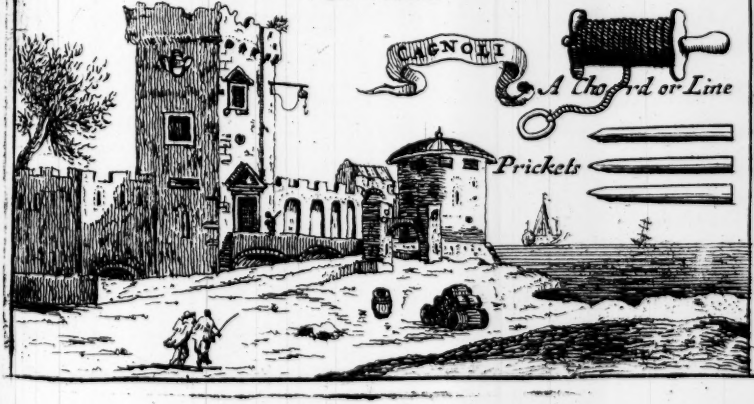
CANNON
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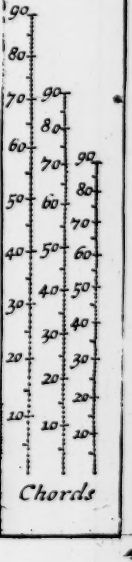
Prickets


Chords

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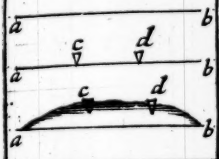

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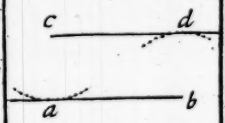

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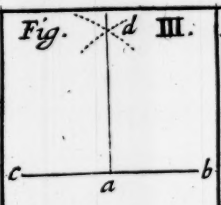

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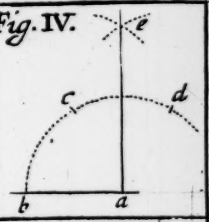

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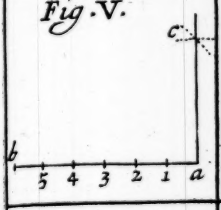

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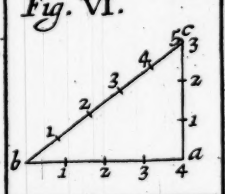

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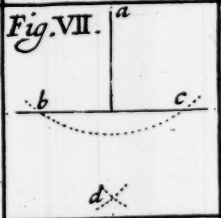

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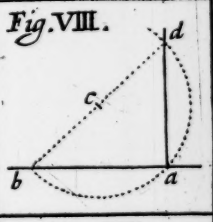

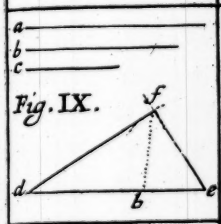

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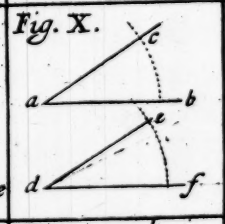

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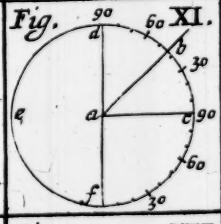

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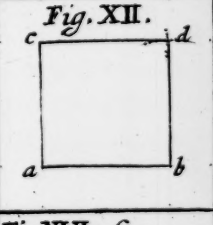

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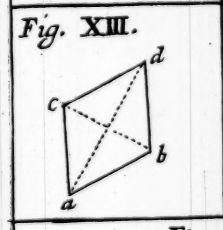

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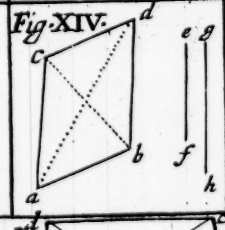

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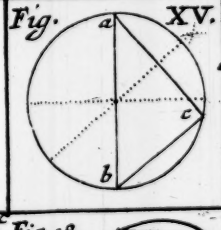

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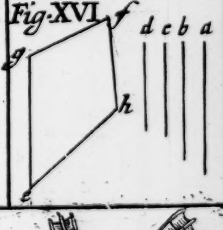

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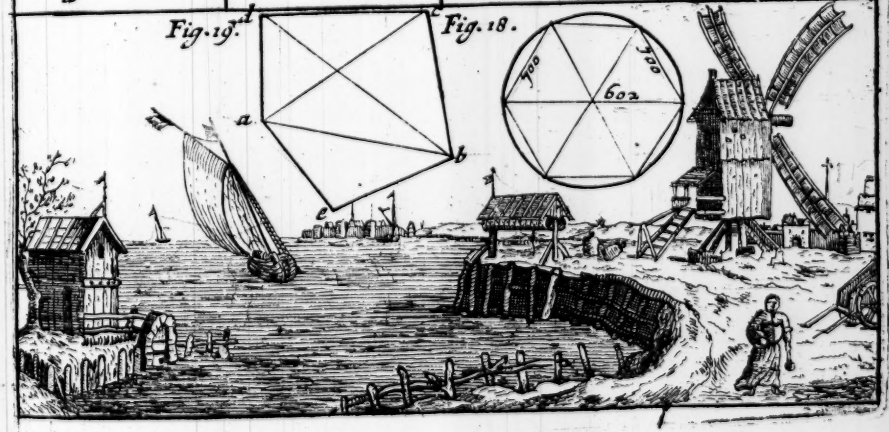

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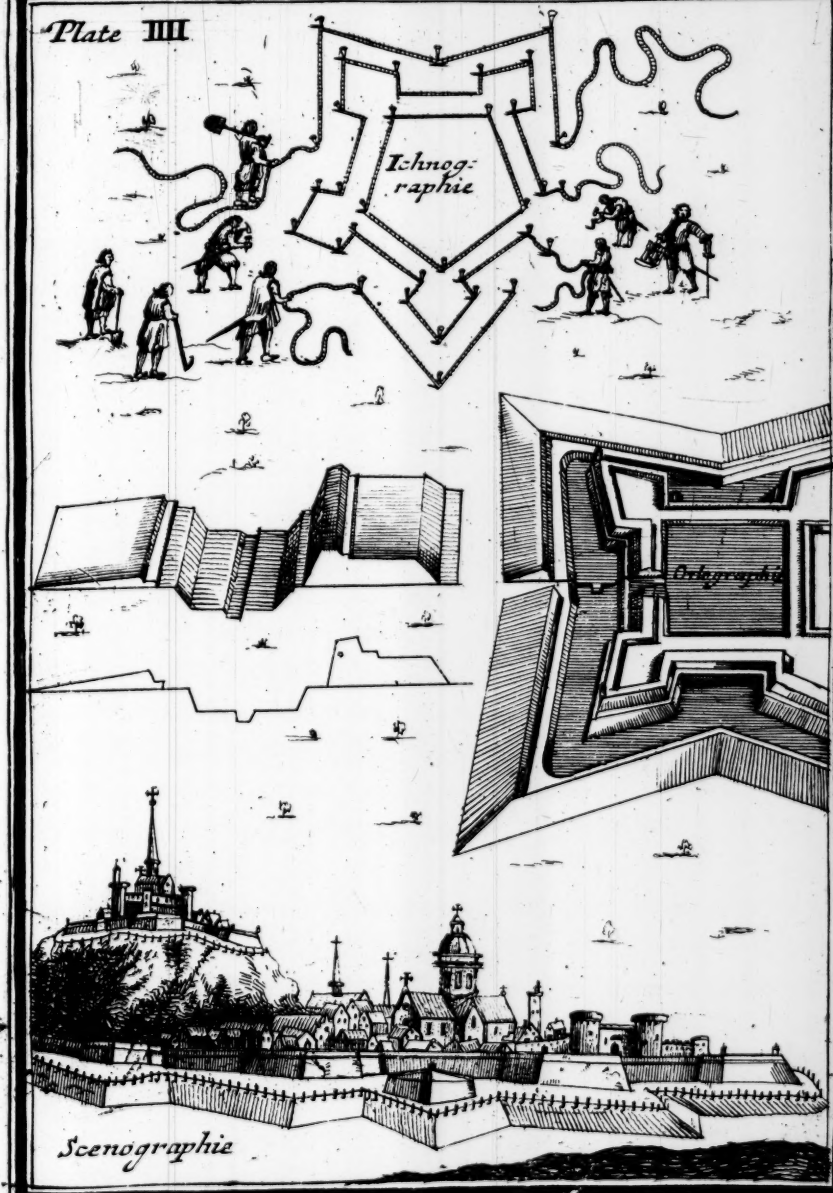

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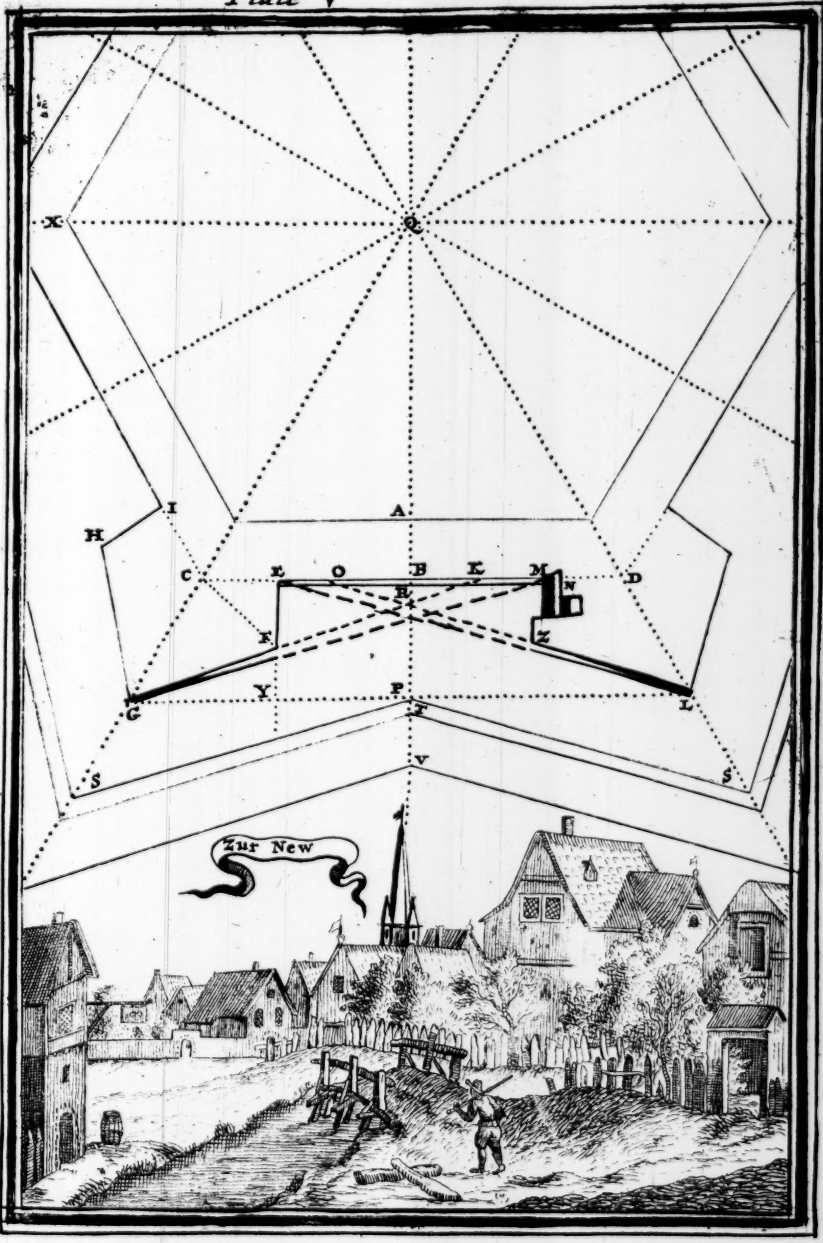
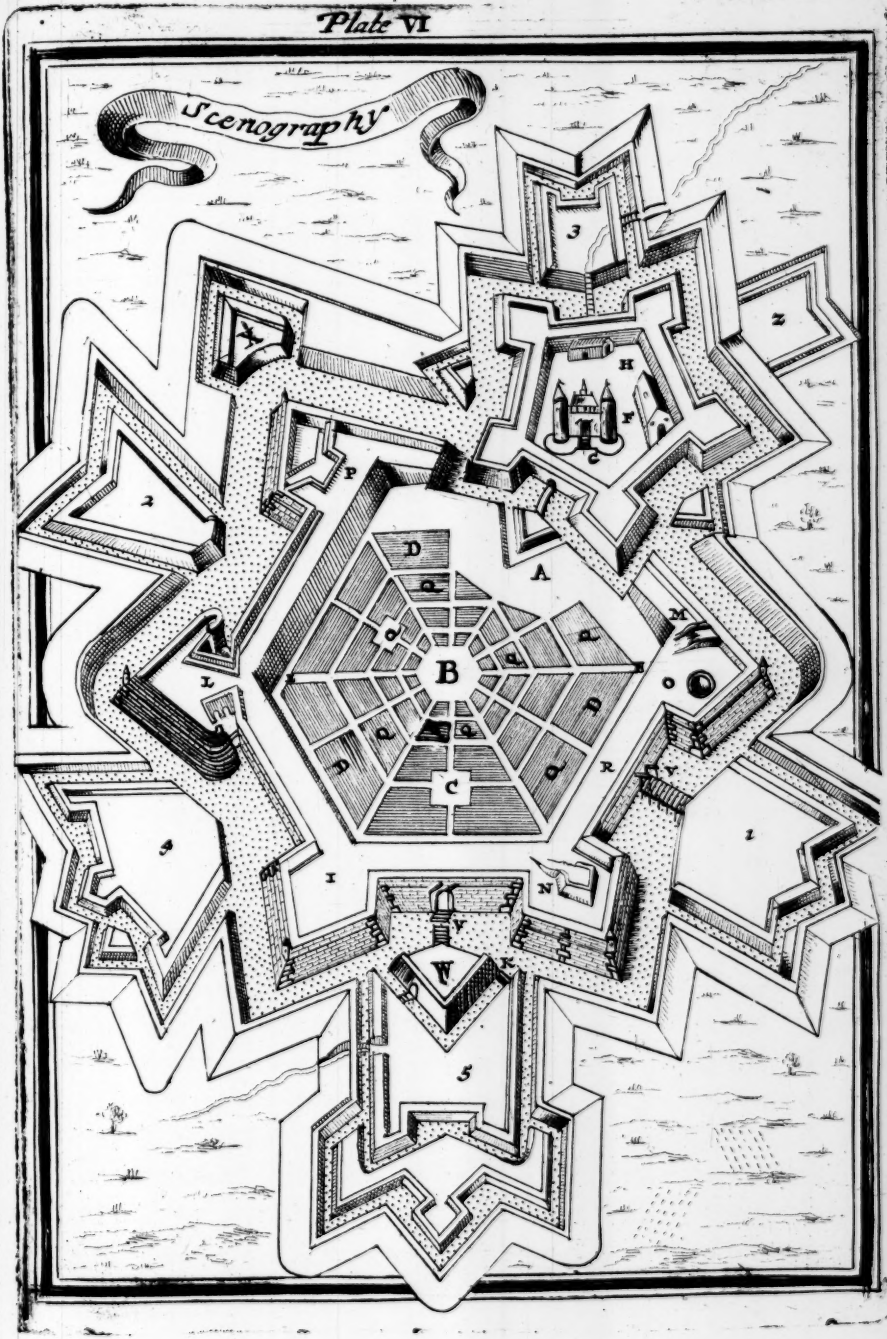


Plate VI



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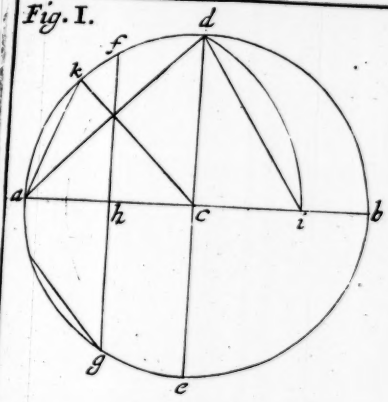

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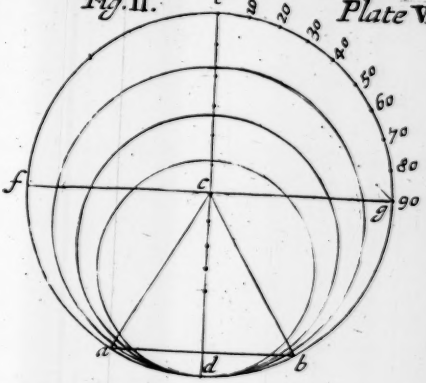

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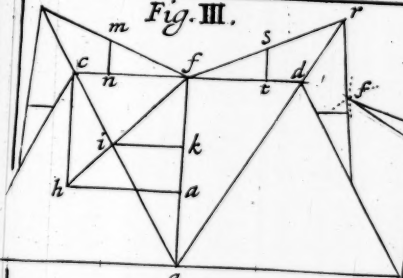

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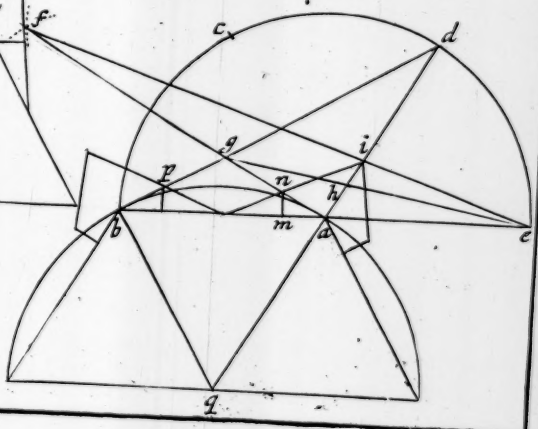

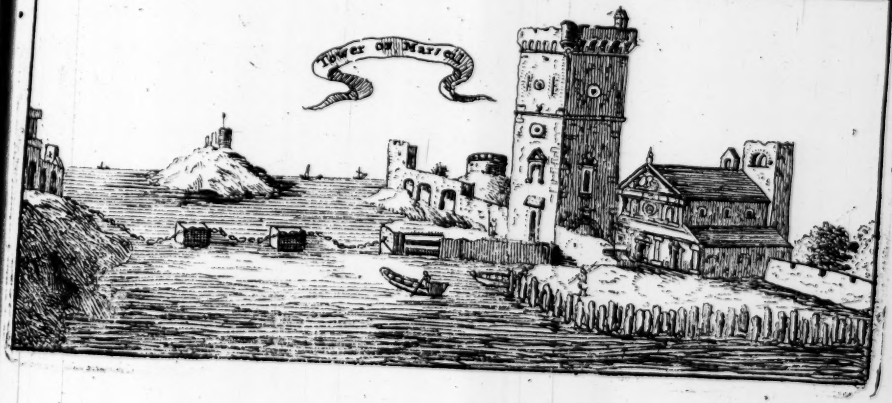

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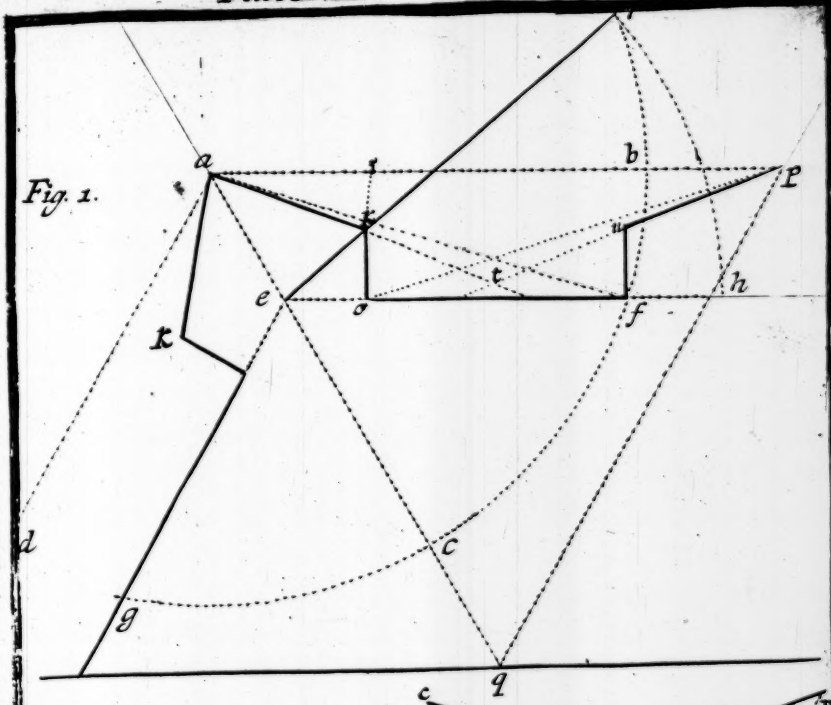

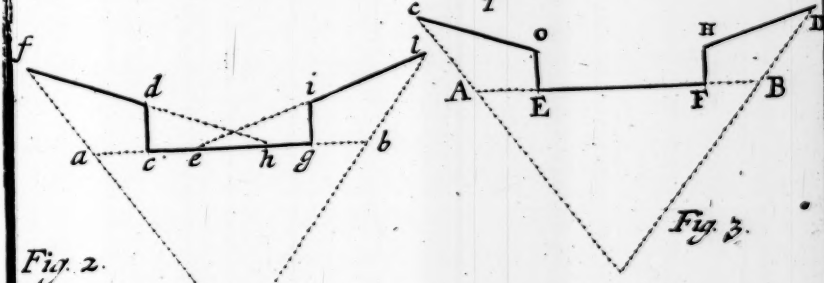

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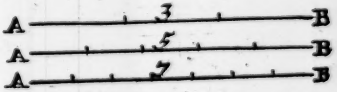

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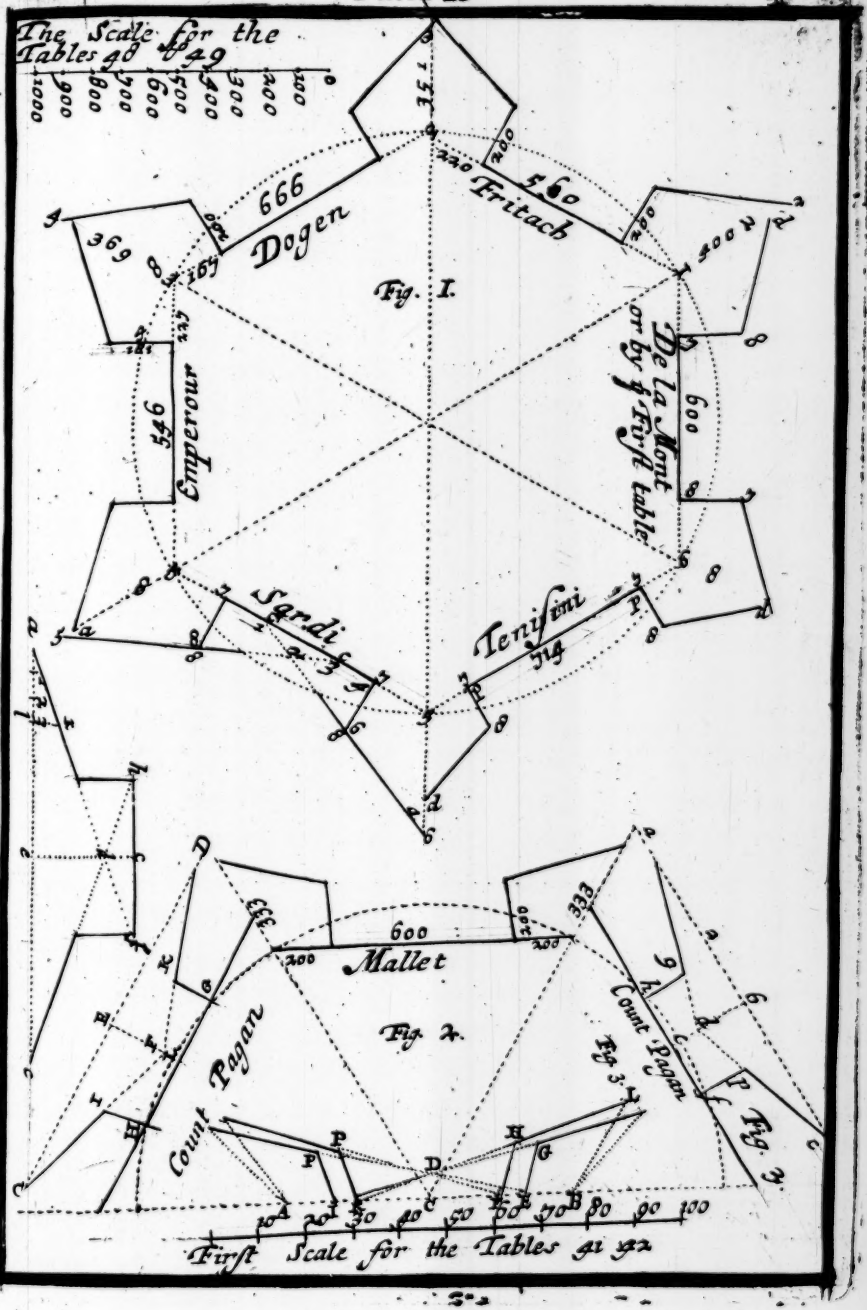
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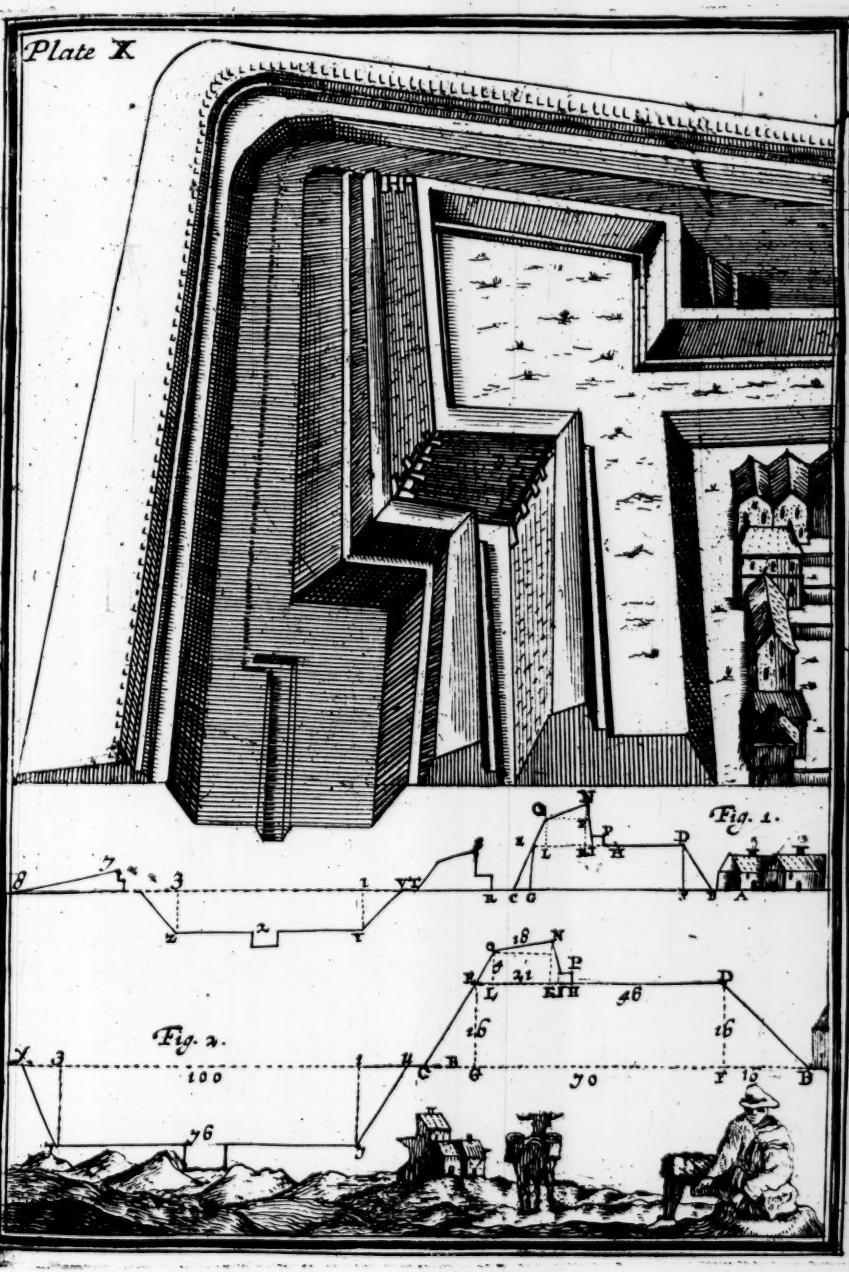

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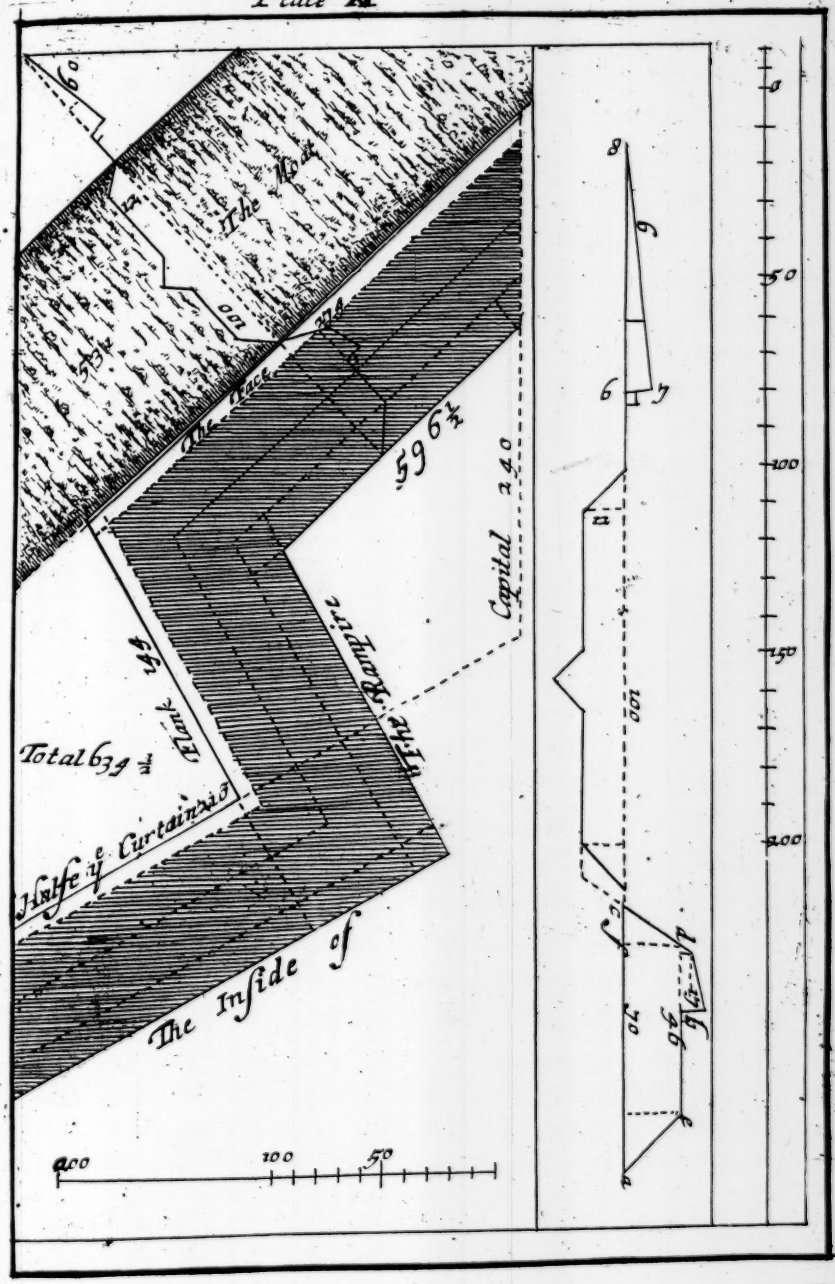

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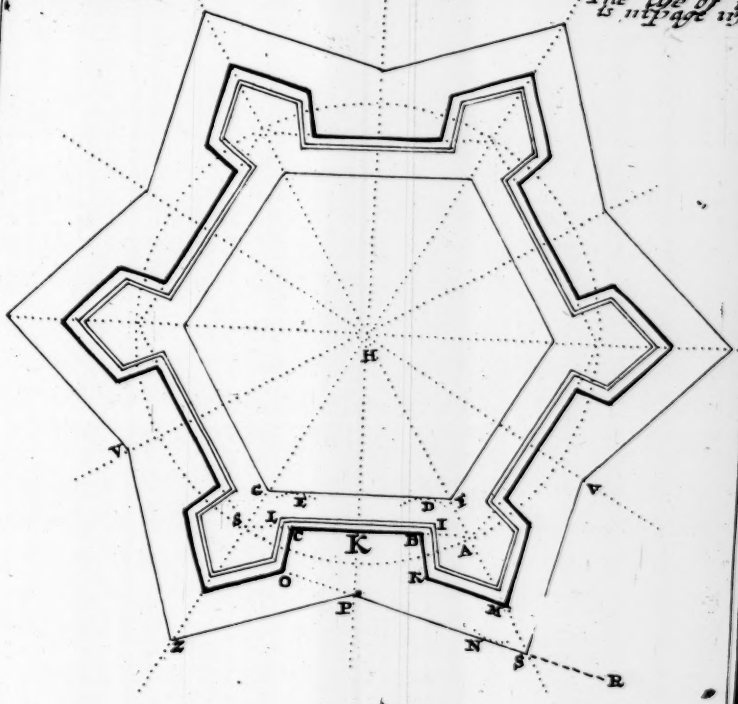

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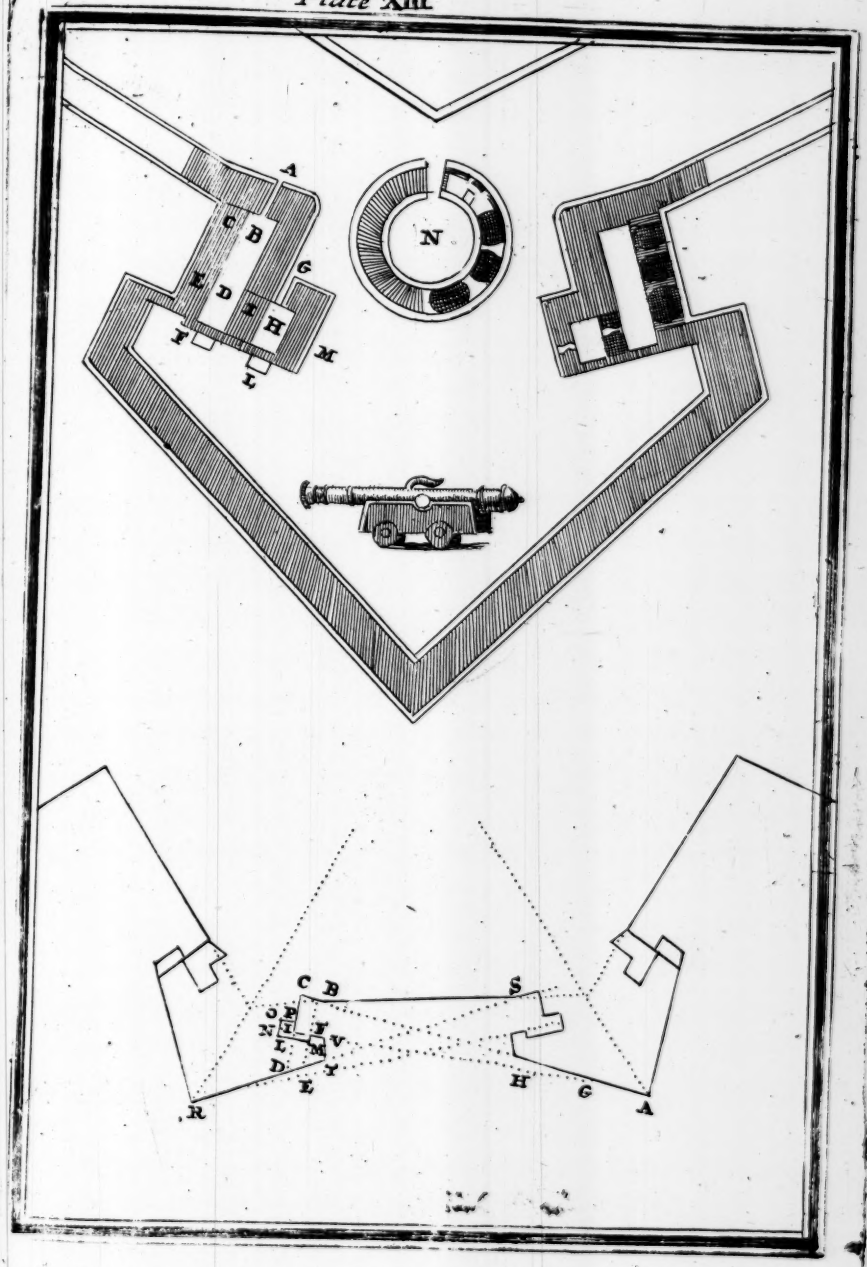

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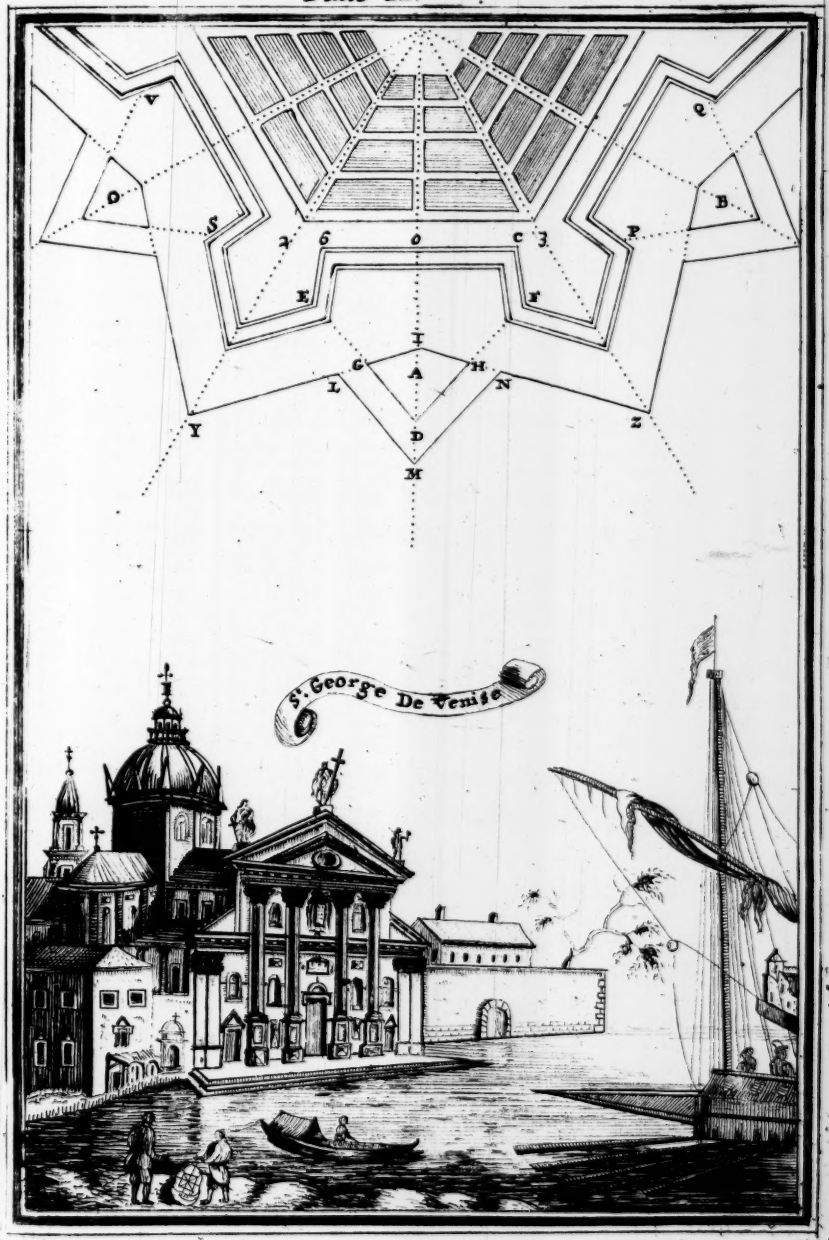

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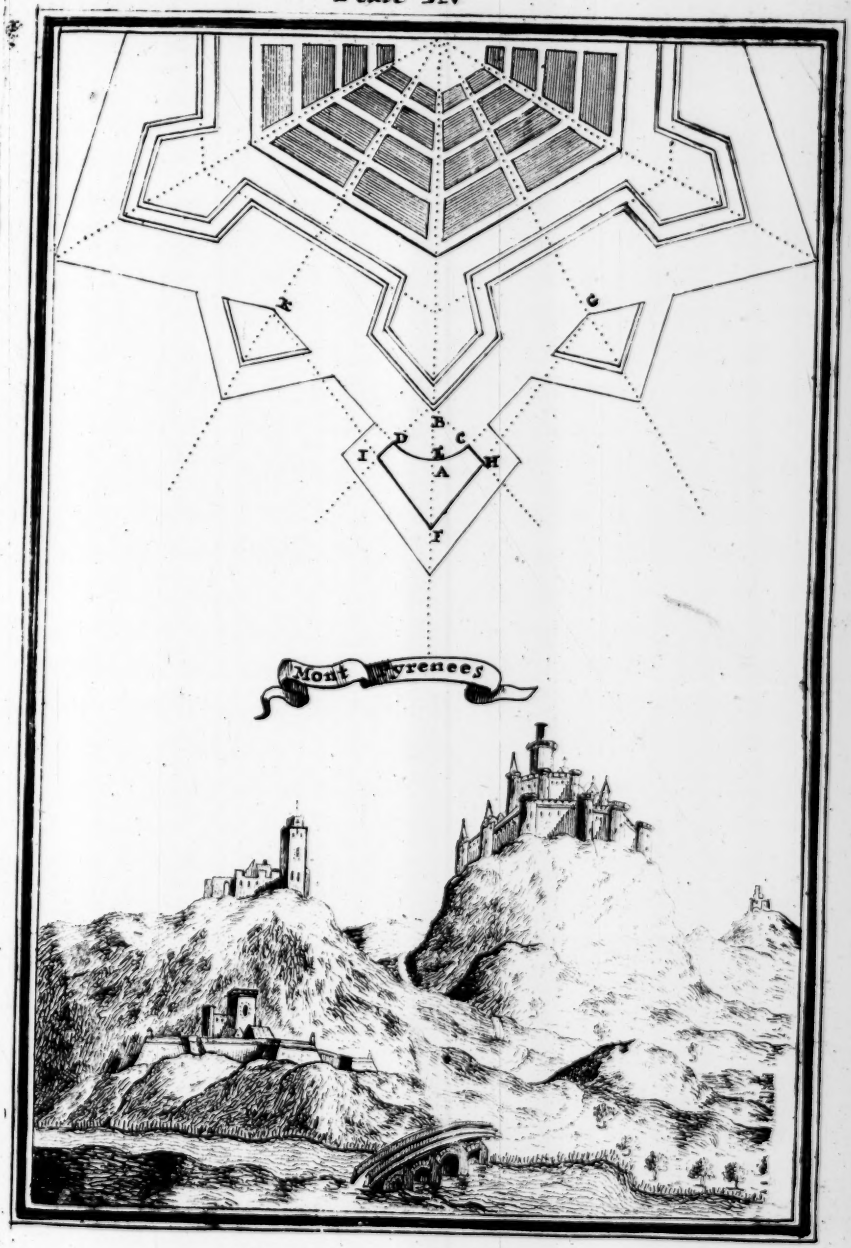

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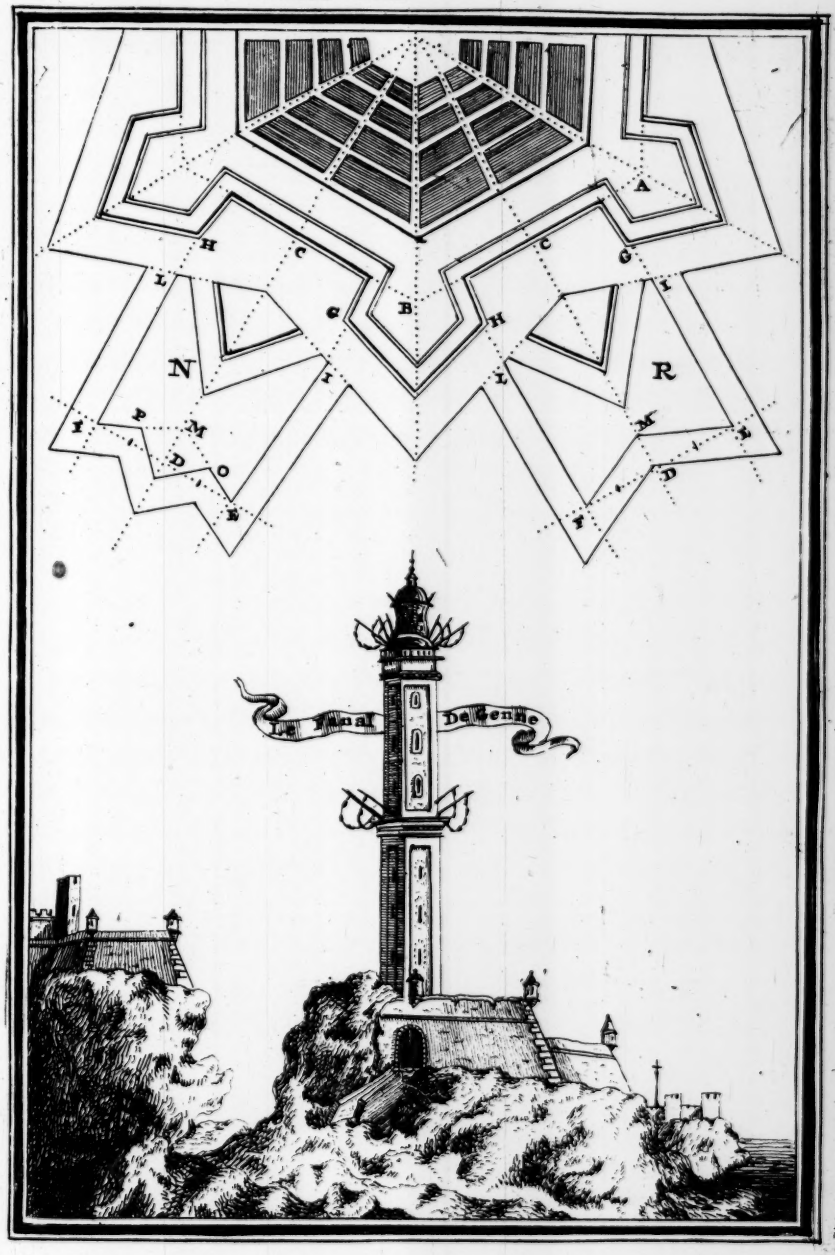

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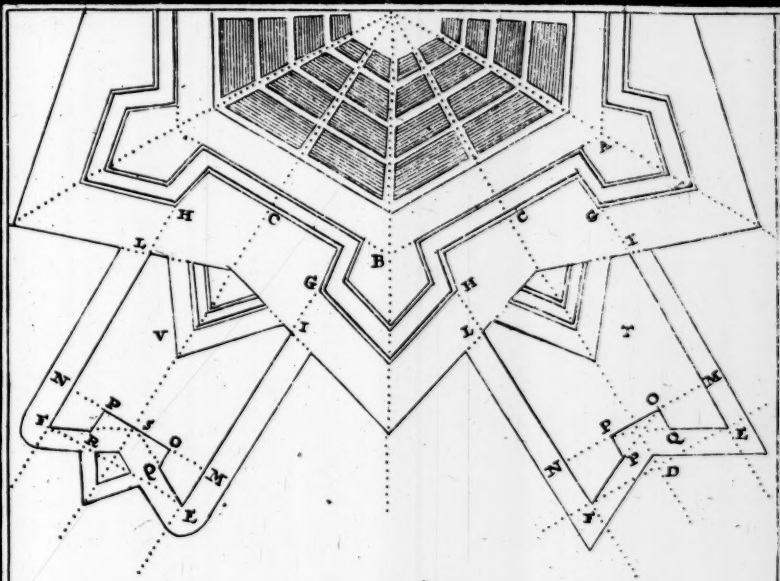
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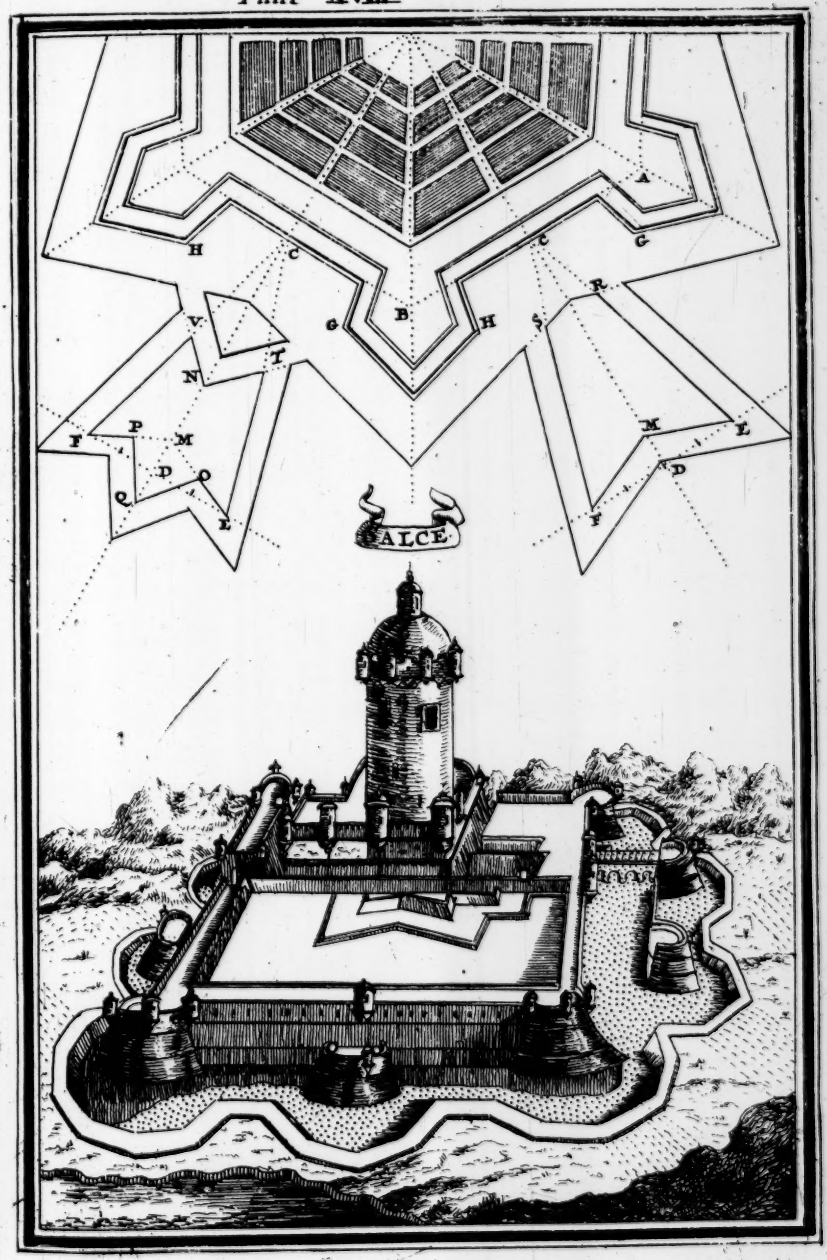

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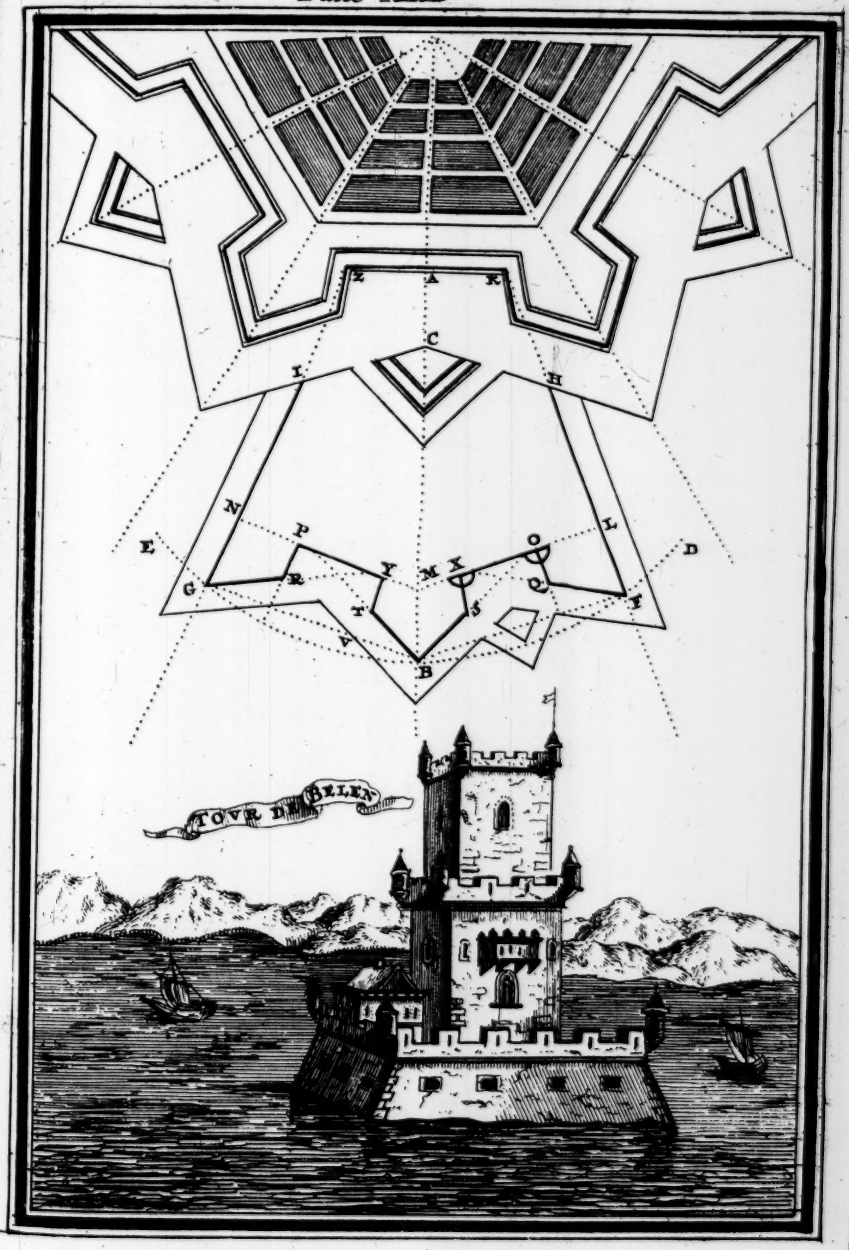

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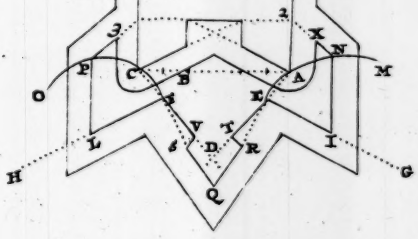

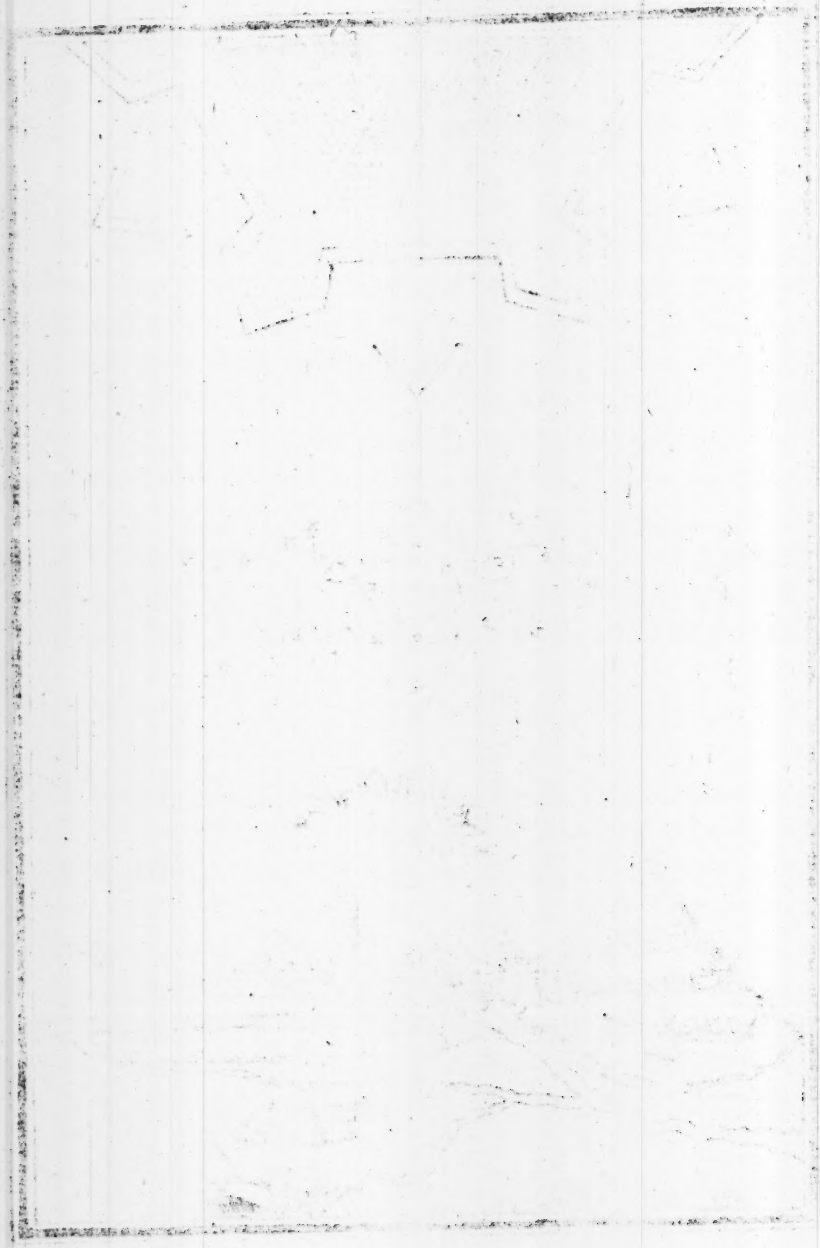

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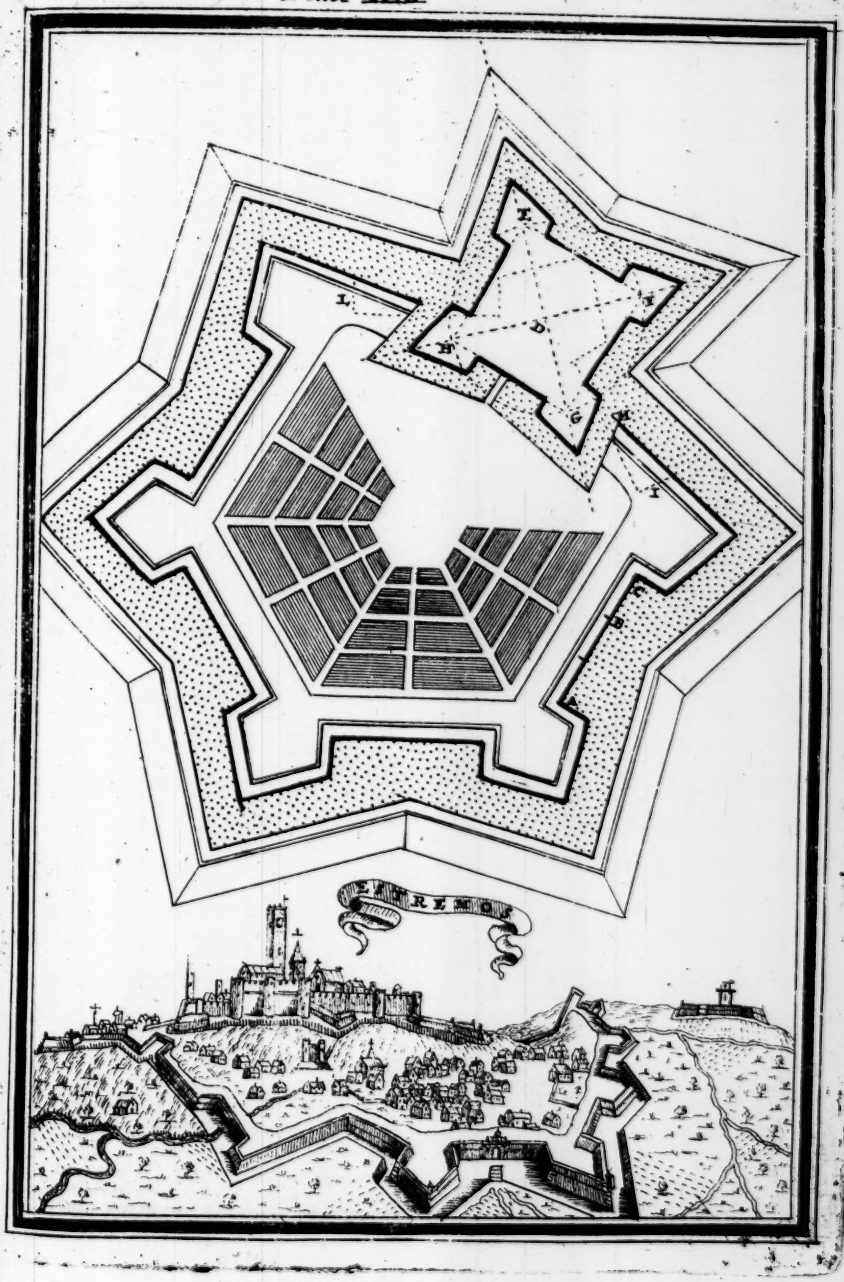

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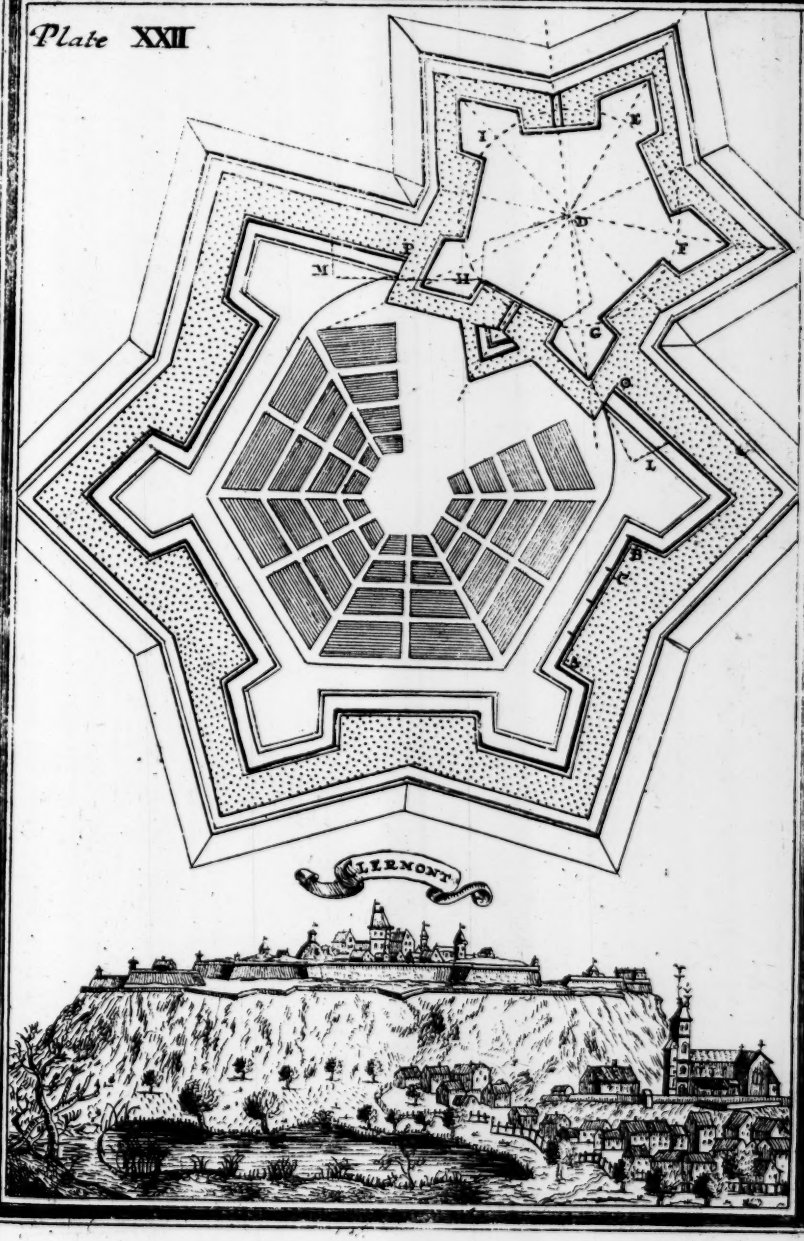

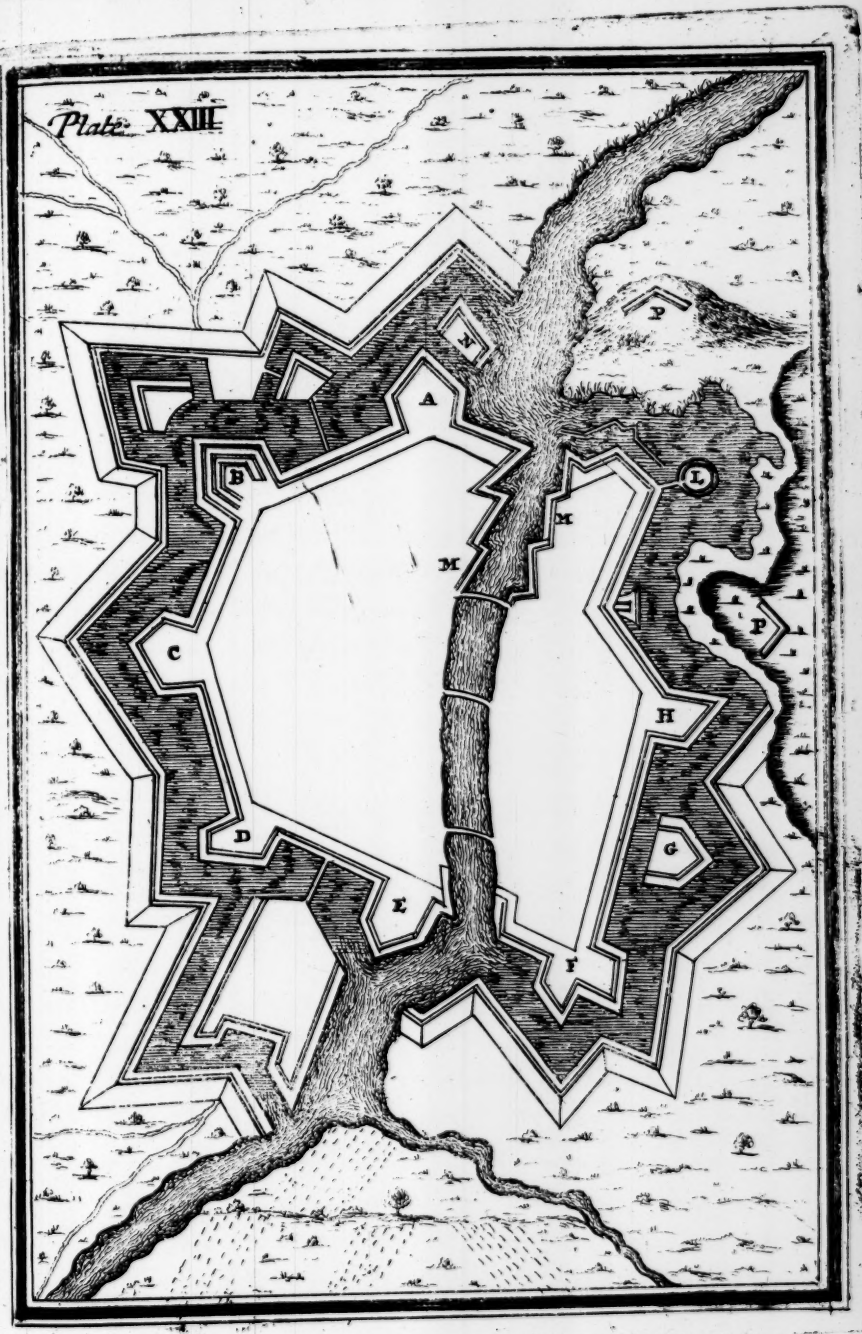
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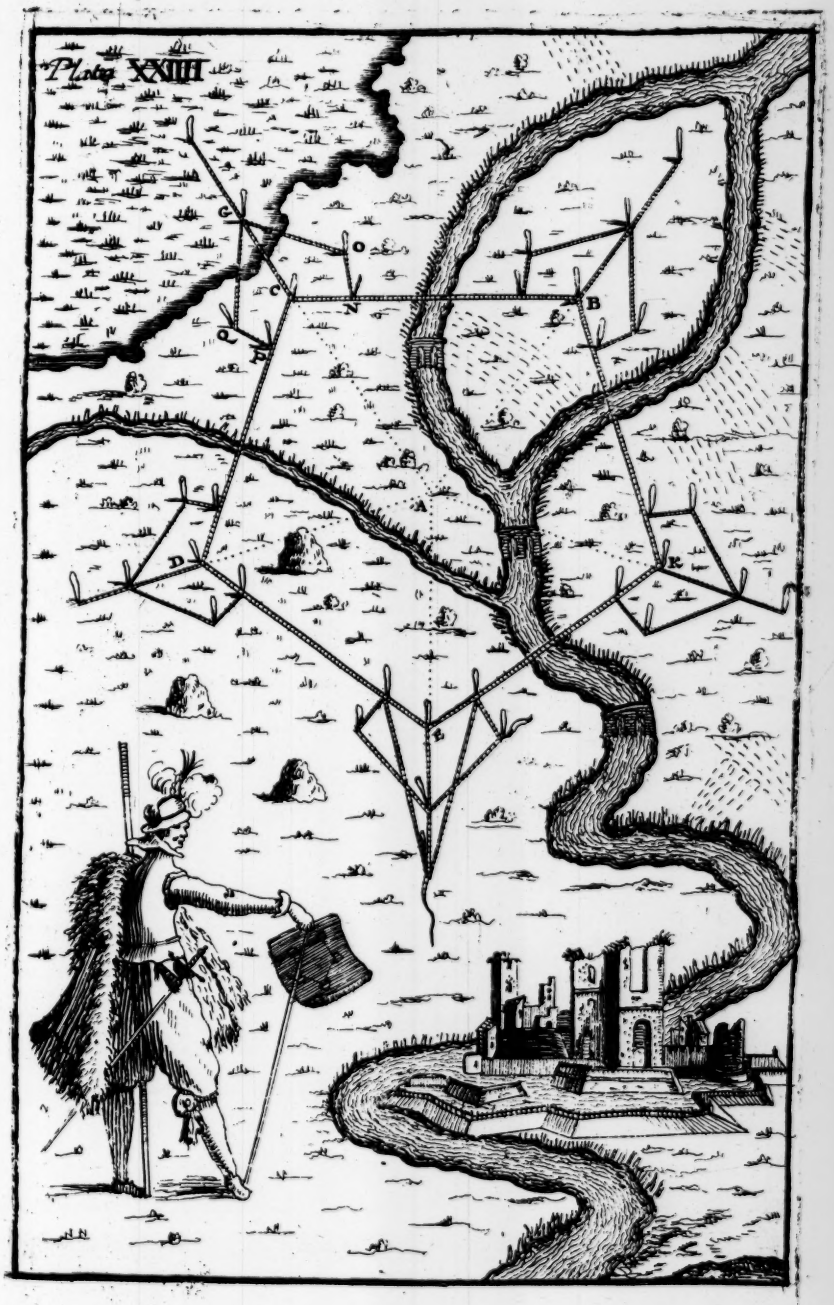
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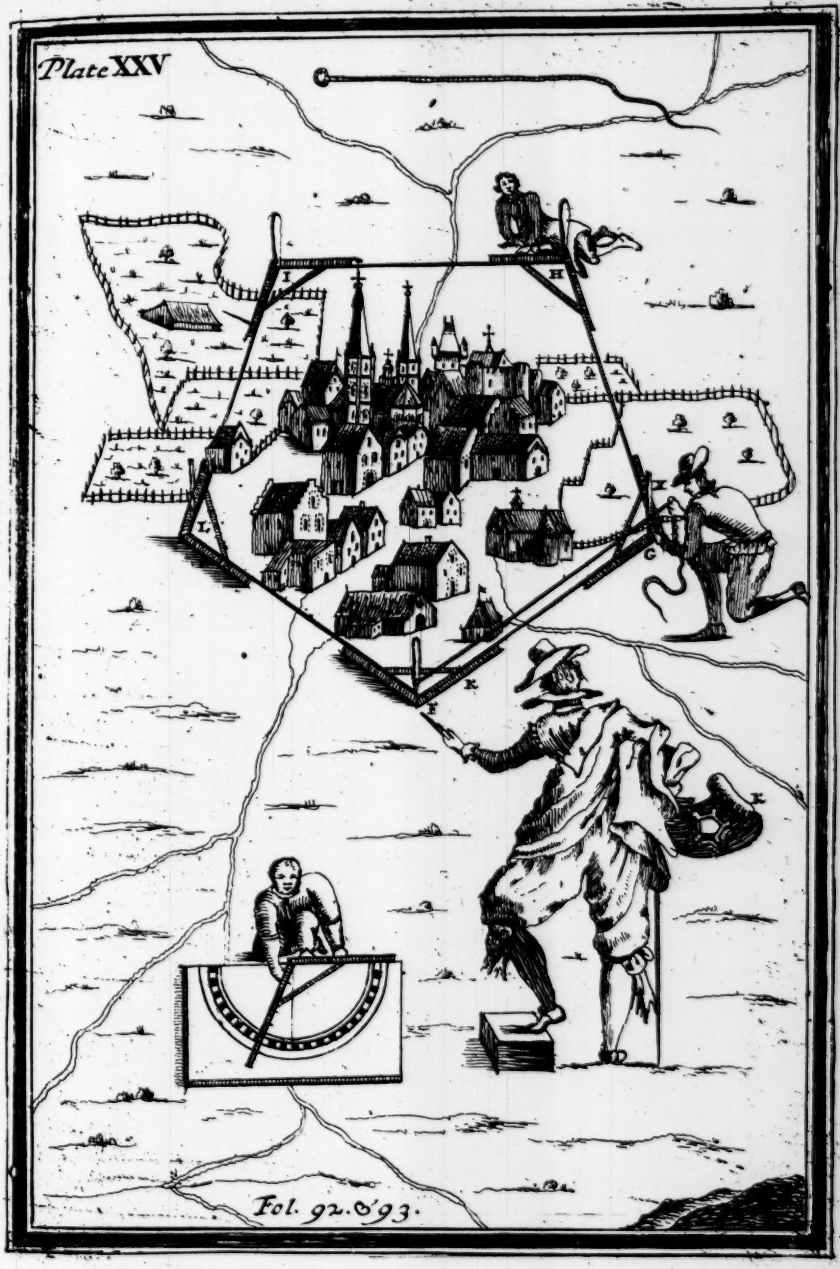

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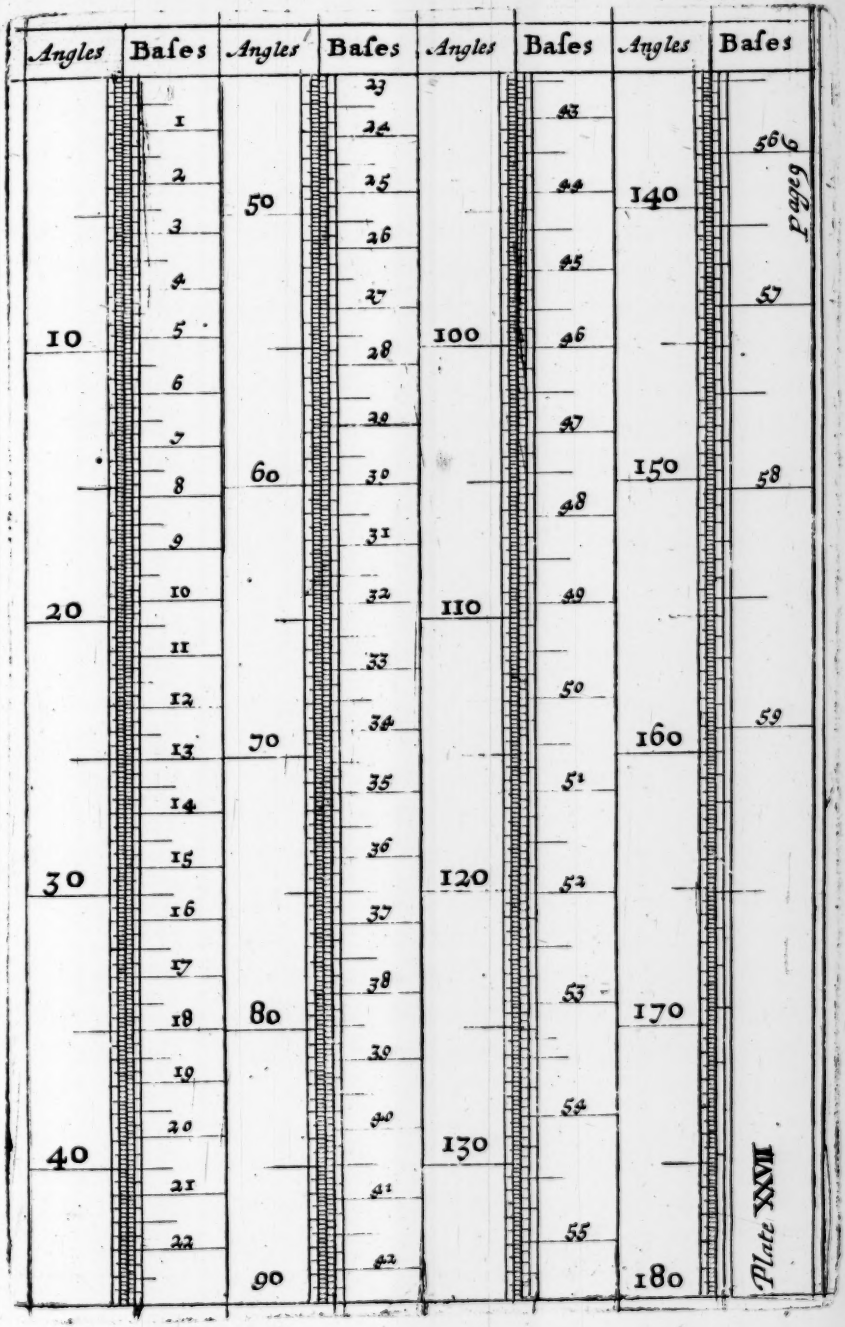
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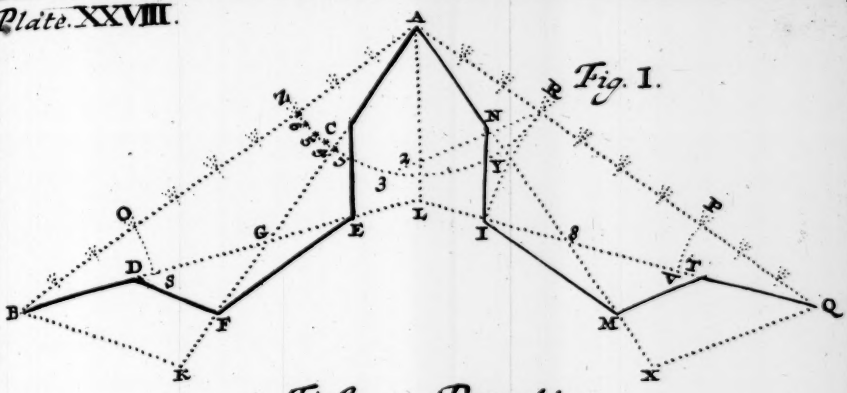

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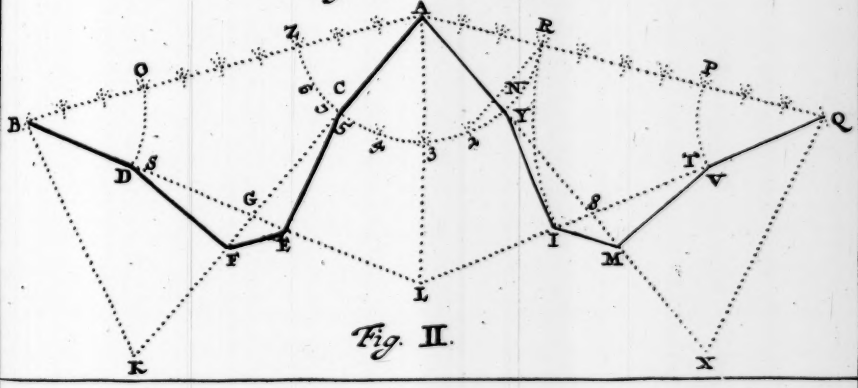

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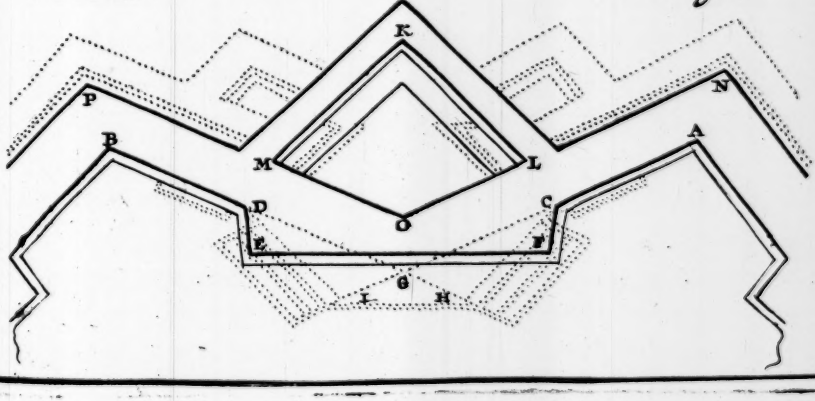

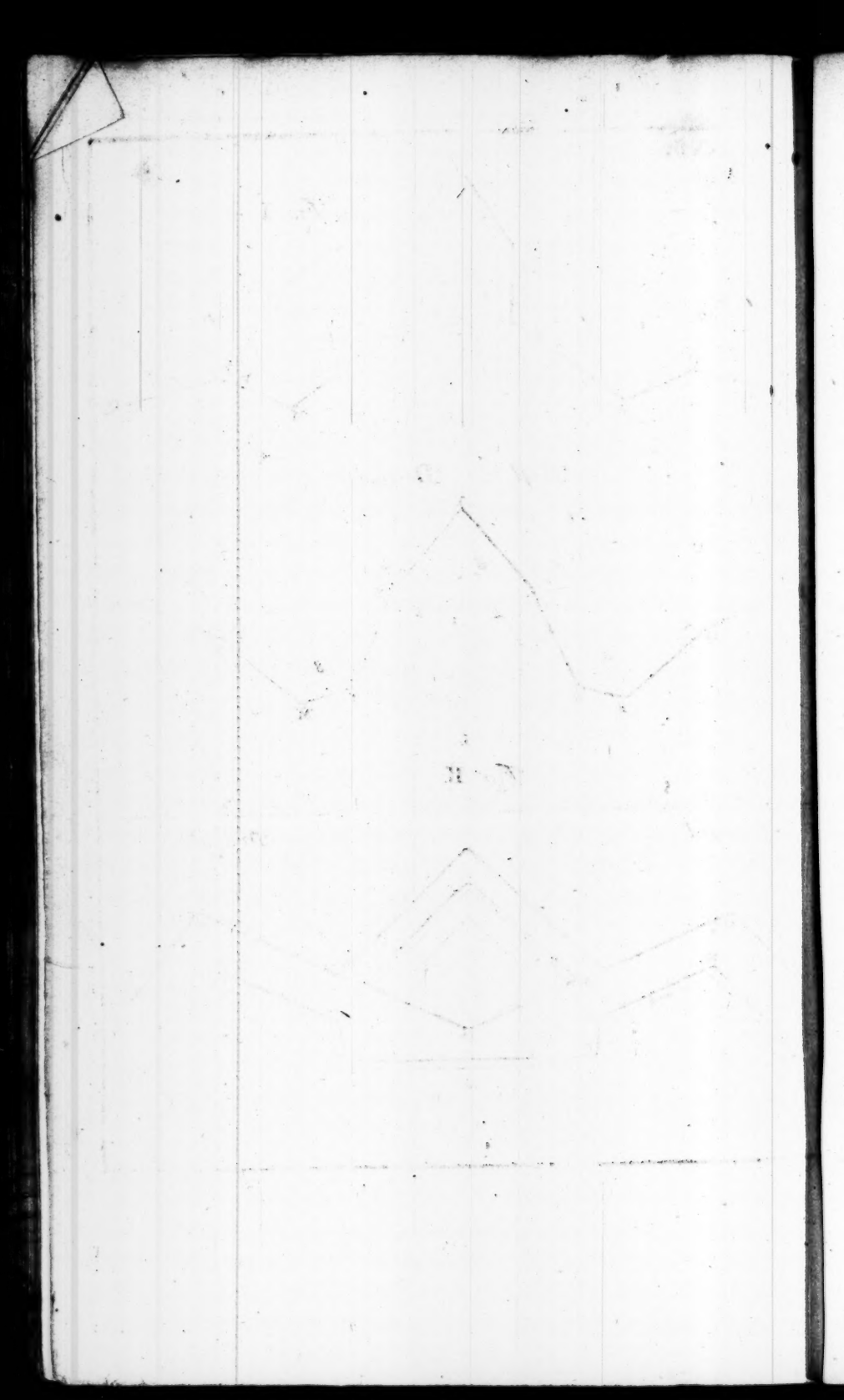

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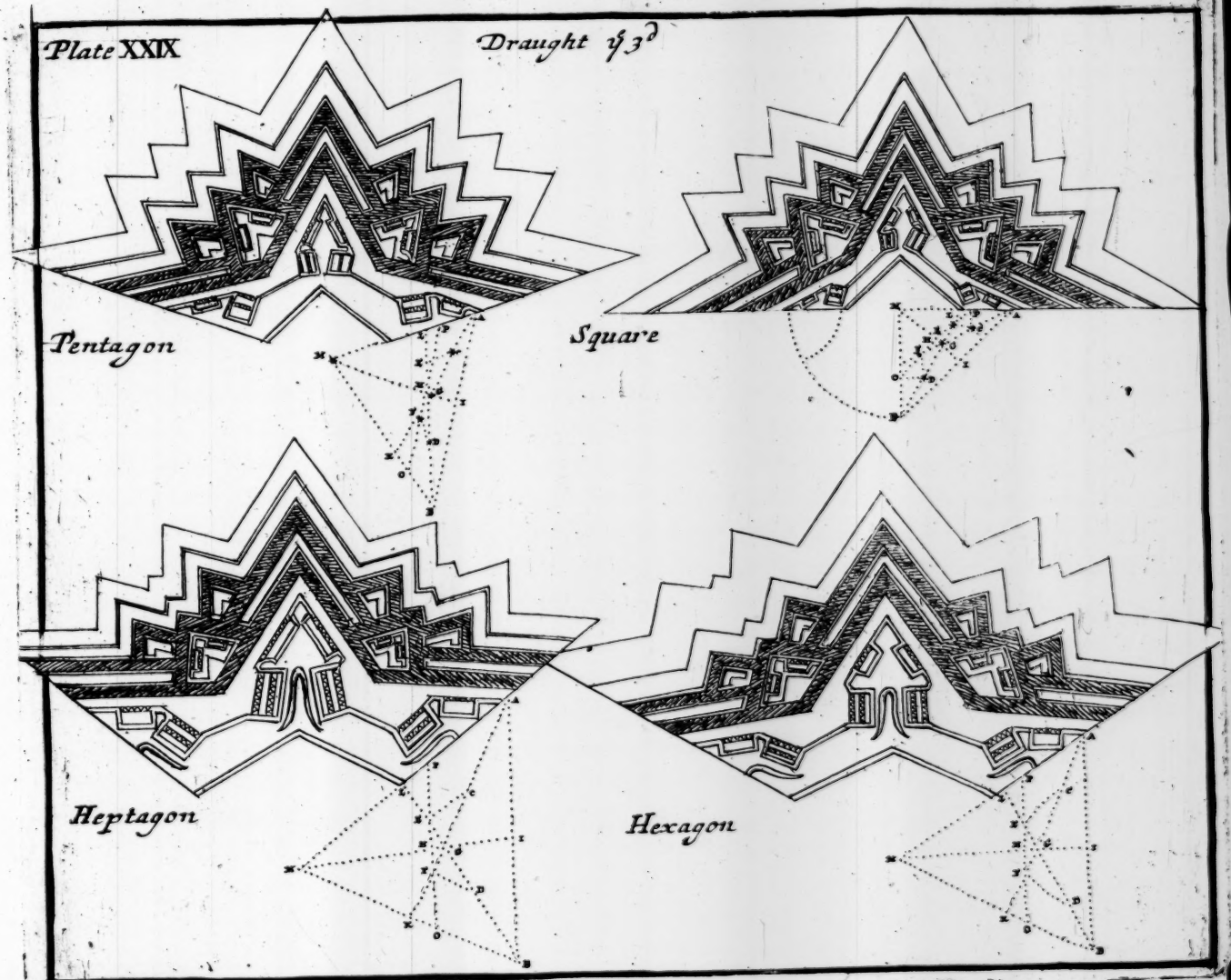
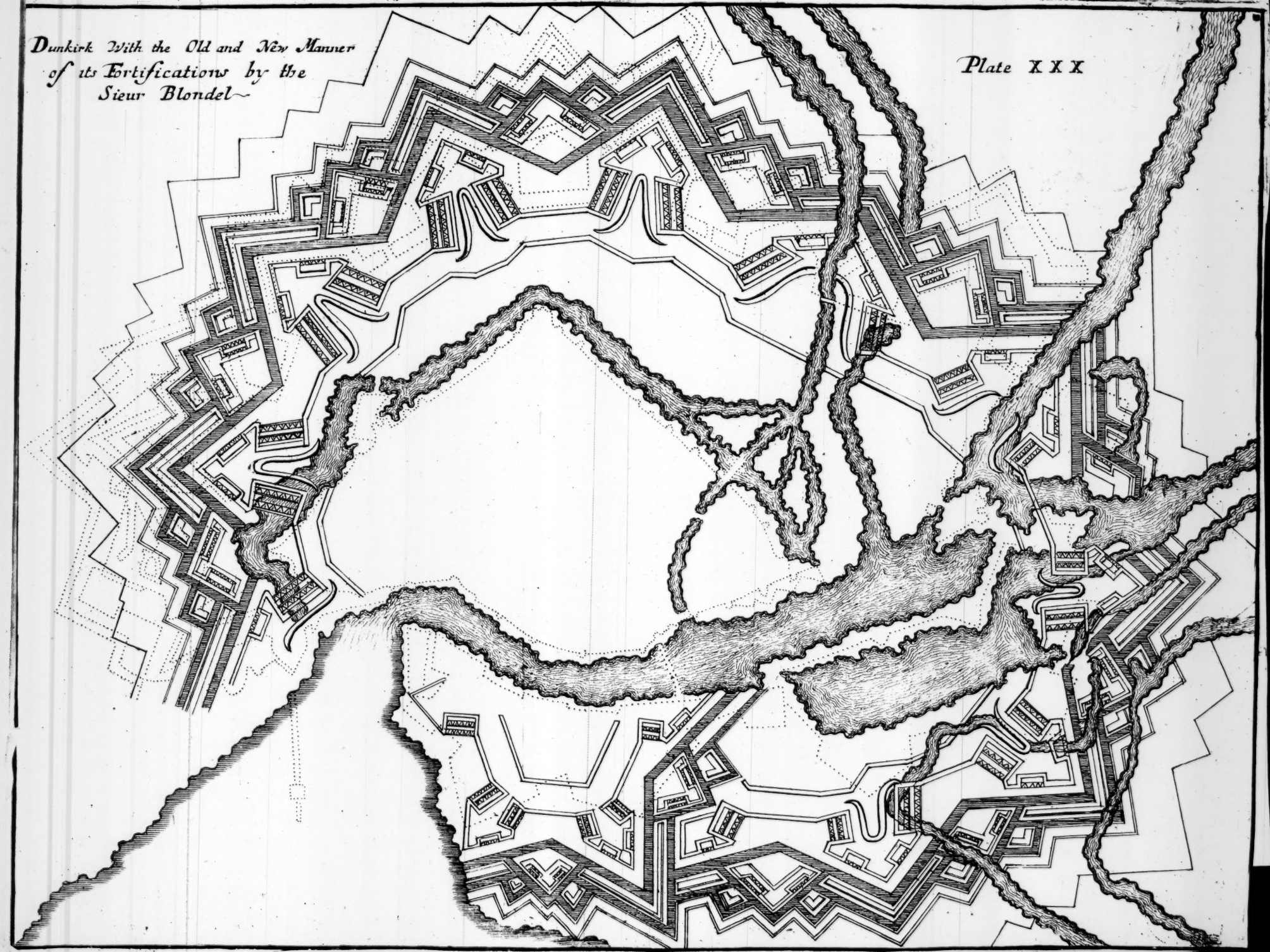
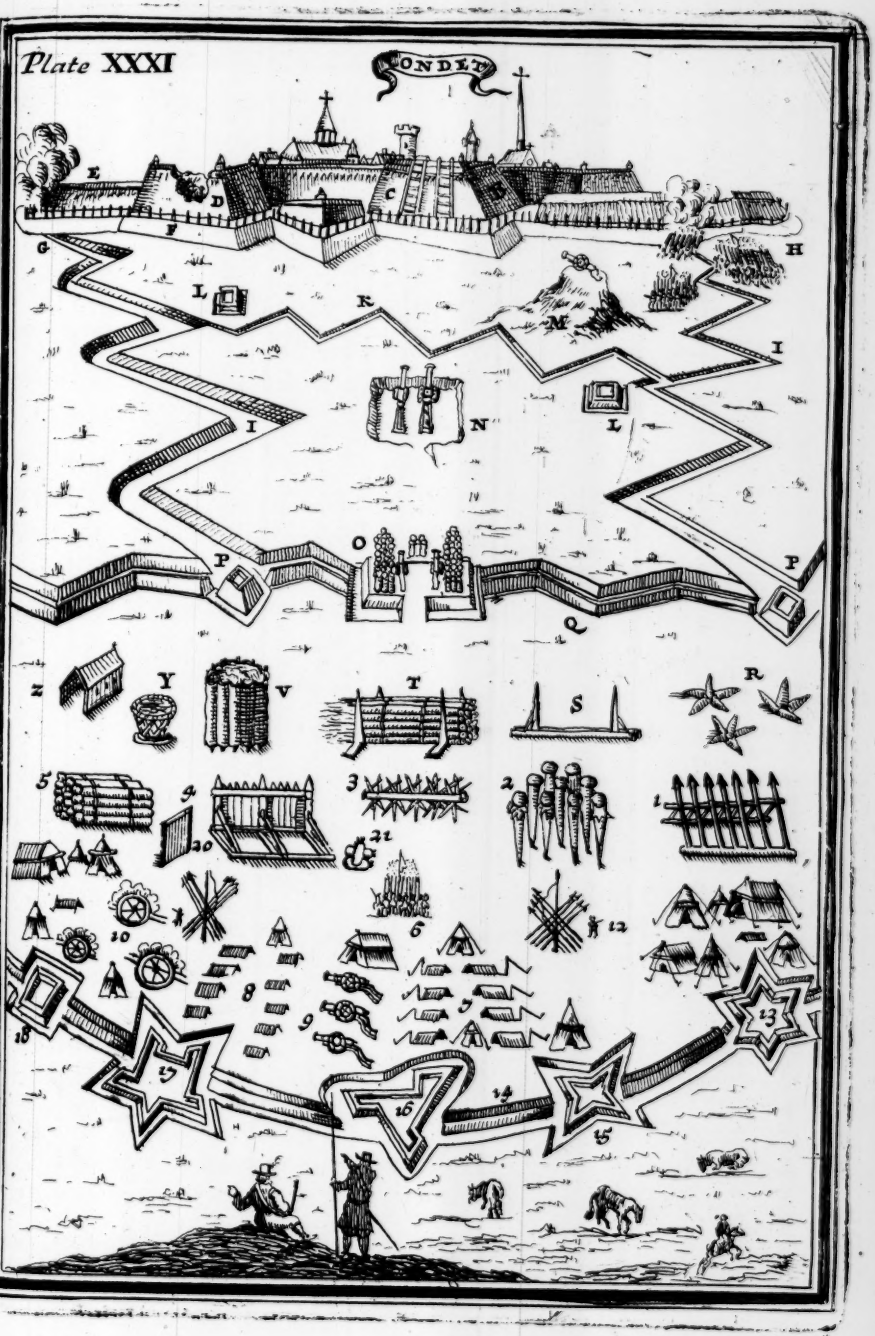


Dunkirk With the Old and New Manner of its Fortifications by the Sieur Blondel~

Plate XXX

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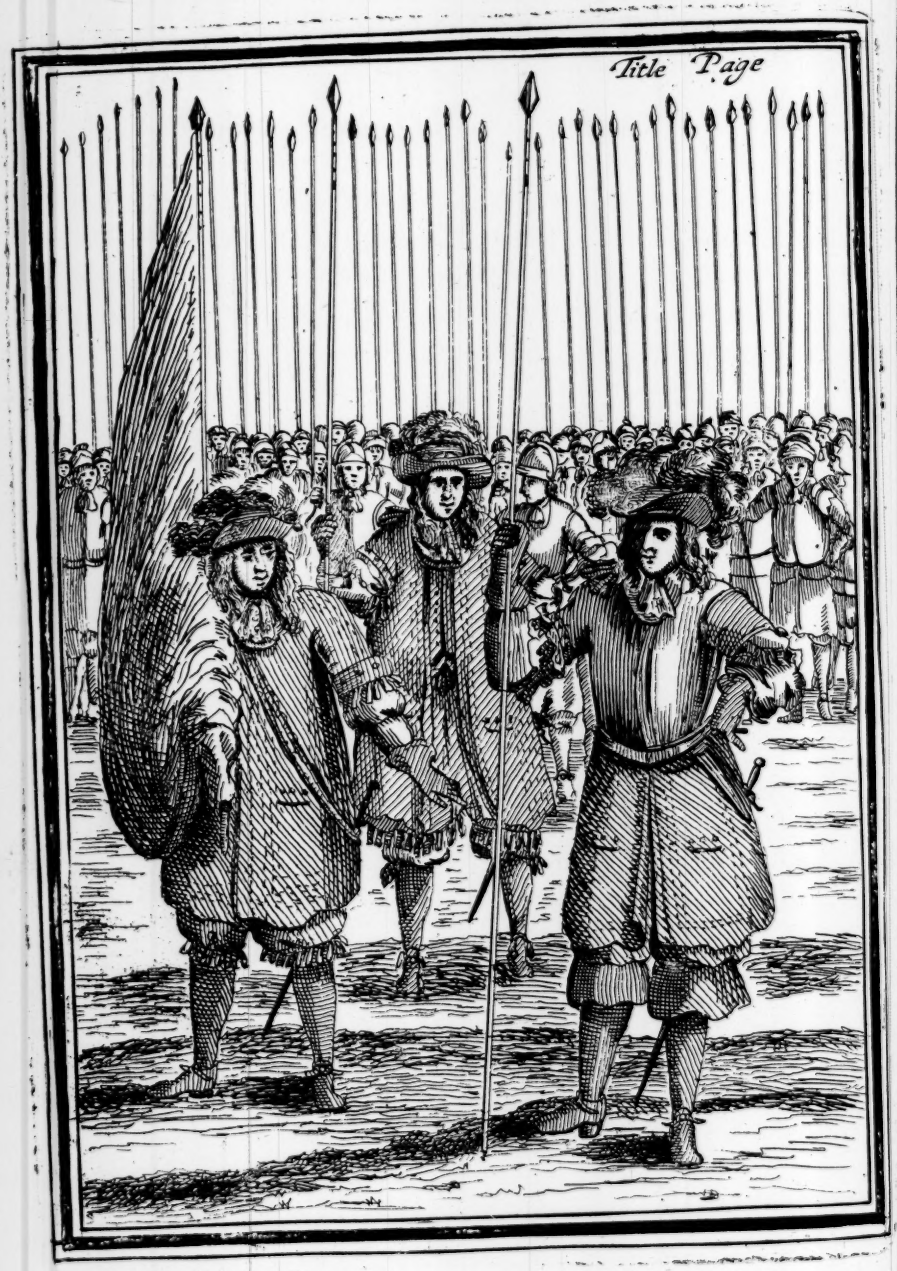
Title Page

Military Discipline;

OR THE

ART of WAR.

SHEWING

Directions for the Postures

IN

EXERCISING

OF THE

PIKE and MUSKET,

THE

Dragoons, Granadeers and Horse;

The Art of Doubling, Wheeling, Forming and Drawing up a Battalion or Army into any Figure, *&c.*

The Method of conducting Armies in Champaign, Hilly or Woody Countries: Of Encampings, Besiegings, giving of Battel, with all sorts of Instructions and other Observations belonging to the whole Art of War: as now practised.

All represented in Twenty several Copper Plates, with variety of several Prospects and other Designs, for the Practice and Exercise of Arms.

Improved and Designed by Capt. *J. S.*

Published and Sold by *Robert Morden*, at the *Atlas* near the *Royal Exchange* in *Cornhill.*

The PUBLISHER
TO THE
READER.

THere *have indeed been many Books written and publiſhed in Engliſh concerning this* Military Art, *that is to ſay, by* Bingham, Hexam, Ward, Elton *and* Venn, *Gentlemen all of great worth and parts. But as in all Ages there have been Wars, ſo the Rules and Maxims thereof have been changed and altered: And thoſe ways which are now in uſe are much different from what was in practiſe in former times, ſo that moſt of thoſe Authours are now almoſt of little or no uſe, though then excellent and of great eſteem. For they who beſt underſtand the* Art of War, *know that*

the way which the French *uſe as it is the beſt ſo it is very different from the practiſe of other Nations, eſpecially in* England. *My deſign therefore being to inſtruct the* Engliſh (*who may not well underſtand forraign Language*) *in that* Art of War *as now practiſed in* France *and* Germany, *I have therefore procured the Tranſlation of the moſt uſefull parts out of Mr.* Mallet, *a Book dedicated to the King of* France, *and of great value and price, as alſo from other* French *and* German *Writers, who are eſteemed the moſt expert and induſtrious: And have been alſo at the charge of engraving all new, the moſt material deſigns and draughts in thoſe Books far beyond what was ever done in* England *before. All which I humbly preſent to all thoſe that eſteem it their Honour to bear Arms for their Prince, and Glory of their Countrey. Heartily wiſhing it may be as ſerviceable*

ceable and advantagious to them, as it hath been very laborious and expensive to me: Then shall I not think my cost ill bestowed, but my time and pains well imployed. For the profession of Arms hath in all Ages been the most honourable and glorious: From hence all Nobility derives its first Original, and from hence are descended the illustrious Families of Lords, Earls, Dukes, Kings *and* Emperours. *And as by Arms men have rendred themselves worthy of the most glorious Employments; so there is nothing to be found in the Histories of the greatest Captains, but Acts of the greatest Vertue and Honour. The Valour of* Alexander; *the Integrity of* Regulus; *the Chastity of* Scipio Africanus; *the Justice of* Fulvius Aulus; *the Prudence of* Cæsar; *the Clemency of* Augustus; *the Generosity of* Titus Vespasian; *and the Conjunction of all these in our*

Great Soveraign James *the* II. *are sufficient examples and proofs of the truth of this. I shall therefore onely add, that History tells how the neglect of Warlike Discipline hath been the Ruine of many* States *and* Countreys : *And that by the orderly and constant practise of it, the Ancient* Romans *became at last great and mighty* Conquerours: *I wish the same to our* English Nation, *that by the Exercise and Practise of this most necessary and honourable* Military Art of War, England *may become no less prosperous at home, than mighty and formidable abroad.*

R. Morden.

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A

TREATISE

OF

Military Diſcipline

OR THE

Art of War

As now Practiſed.

THE Profeſſion of a Soldier is allowed to be ſo Famous and Honourable amongſt Men, that Kings and Emperours have been enrolled in it.

The two chief parts of a Soldier are Valour and Obedience, for there is as much Honour gained by obeying patiently as by fighting valiantly: And as the greateſt Vertue required in a Soldier is Obedience, ſo Induſtry is the chief Magazine wherein the force of all Diſcipline conſiſteth: All the Exerciſe and Labour of a Commander from time to time will be of no value, if the Soldier be not induſtrious and willing to labour after

a perfection, and that Soldier that makes not this Military Art his delight but is given to other pleaſures and paſtimes will never attain to perfection, and conſequently never arrive to Wealth, Reputation and Honour. Therefore it behoves all in their ſeveral Circumſtances and Capacities not to be wanting in their endeavours after the Exerciſe of the Arms, for 'tis not length of Life or Number of Years that teacheth the Art of War, but continual Diſcipline and Practiſe.

Of Diſtance.

Military Diſcipline conſiſteth ſo much in Diſtance and Motion, that there is great Neceſſity of learning this Principle, for if a perfect form of Order be not obſerved, diſorder muſt neceſſarily follow; the effect of which produceth confuſion.

In our modern Diſcipline there are theſe 4 Diſtances in uſe.

1 Cloſe Order.	Which is both in Rank & File.	One foot & a half.
2 Order.		Three foot.
3 Open Order.		Six foot.
4 Double Diſtance.		Twelve foot.

There are 3 ſeveral Diſtances to be performed, 1ſt. In *Marching*, the Diſtance between File and File is 3 foot, between Rank and Rank is 6 foot.

2d. In *Motion* as for the *Doubling* of Files and Ranks, for facing and countermarches between File and Rank is 6 foot.

3d. Diſtances for intire *Doublings* or *Skermiſhes* between rank and file is 3 foot.

4th. Diſtances for prevention of Canon ſhot is 12 or 24 foot,

Double Diſtance.	12	Feet.
Double Double Diſtance.	24	

For

For the better performance of closing and opening of Files and Ranks, take these following Observations, *viz.*

1 When Files open to the right, the left hand file must stand fast.

2 When Files open to the left hand, the right hand stands fast.

3 When Ranks open forward or to the Front, the last Rank stands.

4 When Ranks open backward (or to the Reer) the first Rank stands, *&c.*

5 When Files close to the right, the right hand file stands.

6 When Files close to the left, the left hand file stands.

7 When Files close to the right and left, then they close inward.

8 When Files close to the right and left by division it must be outwards.

9 When Ranks close to the front and reer, then the first and last rank stands.

10 When Ranks close to the midst or right and left inwards, then they close toward the two middlemost Ranks.

Of Facings.

Facing is the turning and altering of the aspects to either hand, *viz.* right, left, Front or Reer. Facings are intire or divisional: intire facing is when the Aspect or Face of the Company is directed one way, *viz.* to the right, to the left, to the right about, to the left about.

Divisional Facings are divers ways, *viz.* to the right and left, to the right and left inward.

Facings are carefully to be obſerved and practiſed as the ground-work of Military Diſcipline, as may appear by theſe 2 following Commands.

[*Command.*] The two firſt Ranks ſtand. The two laſt Ranks face about. The reſt of the Body face to the right and left, and march all.

Fig. 1. *Plate* 2.

To reduce them, 1. Face about to the right, march and cloſe your diviſions, 2. Face to your Leader.

[*Command.*] Muſqueteers face to the right and left. Half files of Pikes, face about to the right, march all.

Fig. 2.

To reduce them. [*Command.*] Face all about to the right, march and cloſe your diviſions, face all to your Leader.

Of drawing up of a Company. Plate I.

Firſt know that a file is a ſequent Number of men ſtanding one behind another from the Front to the Reer in a right line, as BH.

2. A Rank is a row of men ſtanding or marching ſhoulder to ſhoulder even a breaſt in a ſtrait line from the left to the right, as AB.

3. In preparation to exerciſe Files muſt be made up firſt, and being joyned together Ranks are made.

A Number of men thus drawn up as in A conſiſting of Pikes and Muſquets there is according to the rules of Art, Firſt the front or file Leaders AB. the Reer or bringers up GH. EF. the half file Leaders CD, Bringers up to the front half files AG. the right Flank or Wing BH. the left Wing or Flank AGIK. half Ranks to the right BHLM. half ranks to the left AGNO is a quarter of the half

half right Wing BHPQ a quarter of the half of the left Wing.

Of forming a Battalion. Plate I.

A Battalion conſiſteth in Pike-men or Muſqueteers, and theſe in the drawing of them up into Companies are divided into 3 parts, all the Pikemen make one part, which are drawn up in the middle, and the Muſqueteers in two parts, one at the right hand the other at the left hand, as you may ſee Fig. AA. The ſeveral Companies being drawn up in the place of Rendezvouze, the Major or Officer in Chief commands the Serjeants to mark the half Ranks, that he may make the Pikes enter into the Center of the Muſquets, then the moſt ready way to form a Battalion is by theſe words of command.

Have a care to form the Battalion.
Muſqueteers to the right and left outwards.
Pikes to the right and left inwards.
March interchanging ground.

Then pikes and muſqueteers interchanging ground, the firſt rank of pikes paſs before the firſt rank of muſqueteers, and march, both together through the intervals of the ranks till the pikes come to the Center of the Battalion ſeparated from the muſqueteers, and the muſqueteers on the right and left ſeparated from the pikes, when this motion is performed, the Officer reduces them as they were by this word of command.

As ye were.

Then every one faces the Officer, and ſo the Battalion is formed as at fig. A.

Of Exerciſing.

When the Regiment is in Battalia, the Officer in chief is to place himſelf before the body of the pikes about 40 paces from them, ſo that he may the better obſerve what is done, and be the more eaſily underſtood by the whole body; the Commiſſion Officers are to take their poſts at the Head of the Battalion as the Colours are drawn; the Serjeants ought to be two on each rank, at the right and left and the reſt at the Reer; the Drums one half on the right and the other on the left, ranging directly with the firſt rank of the Soldiers; the Hoboys on the right of the Drums, *&c.*

Before you begin the Exerciſe; the firſt word of command is *Silence.*

The next word of command is *Files, open to the Right* (or to the left) *to your Order, march.*

At which word every Soldier turns to the hand named, and the Serjeants on the flank lead the ranks, which are then files, directly forward with their Halberts advanced; In this motion, no man is to ſtir till his Leader be four foot from him, and then to move and keep at that diſtance, and if they move to the right, every man is to obſerve his left hand man, and if to the left his right hand man, that is, to keep in a ſtrait line and equal diſtance to their right hand man, and file Leader, by whom all the reſt are governed; when the Officer ſees the files are ſufficiently opened, which is aſſoon as the laſt man but one of the firſt rank ſtirs his foot; He ſays to them *Halt, as you were,* or *to your Leader.*

Even your Ranks, ſtraiten your Files. Here the Captains and Lieutenants are to carry their pikes com-

comported when they move to the right or left and the Colours to be advanced. The Sergeants are to have a care to keep the Ranks even at 12 foot diſtance, and the Files at 3.

All things thus diſpoſed the chief Officer gives this word of command to the Officers at the head of the Battalion; [*Gentlemen Officers have a care of the Exerciſe*;] at which word of command the Muſqueteers are to pull off their right hand Gloves, and put them under their Girdles, and the Pike-men are to joyn their left hands to their Pikes even with their Shoulders. Then, [*Officers take your poſts of Exerciſe in the Reer. March.*]

The Officers facing to the right about, the Captains marching in one rank, and the Lieutenants and Enſigns in another, till they come into the Reer, and place themſelves in Ranks, the firſt 13, and the other 11 paces from the Soldiers. And at the ſame time 6 of the Sergeants at the Reer, march through the intervals of the Files into the Front, and poſt themſelves ſix paces advanced before the Commander in chief where they are to range themſelves in a parallel Line with the Battalion to keep the Front clear.

Now the Muſqueteers being ſhouldered, and the Pikes advanced, ſilence being commanded, the Officer in chief commands as followeth, *viz. Order your Pikes, To the Right, To the Right, To the Right, To the Right: To the Right about; As you were. To the Left, to the left, to the left, to the left: To the left about; As you were.*

Exerciſe of the Fire Lock.

The Soldiers are to have a care to make no motion untill the word of Command be given and

ended; for that the handling of Arms and the motion muſt be done at the ſame time.

Muſqueteers have a care to the Exerciſe; Carry your Arms well. Lay your right hand on your Muſquets. Poize your Muſquets. Reſt your Muſquets. Cock your Muſquets. Gard your Muſquets. Preſent. Fire. Recover your Arms. Half bend or half cock your Muſquets. Clean your Pans. Handle your Primers. Prime. Shut your Pans. Blow off your looſe Corns. Caſt about to charge. Handle your Chargers. Open them with your Teeth. Charge with Powder. Draw forth your Scowrers. Shorten them to an Inch. Charge with Bullet. Ram down Powder and Ball. Withdraw your Scowrers. Shorten them to a Handfull. Return your Scowrers. Poiſe your Muſquets. Shoulder your Muſquets. Poize your Muſquets. Order your Muſquets.

Exerciſe of the Pike.

Pike-men take heeed. Advance your Pikes. To the Front, Charge. To the Right (4 times.) Charge. To the Right about. Charge. As you were. To the Left (4 times.) Charge. To the Left about Charge. As you were. Charge. Advance your Pikes. Shoulder your Pikes. Charge to the Front. As you were. Charge to the Right. As you were. Charge to the right about. As you were. Charge to the Left. As you were. Charge to the left about. As you were. Port. Comport. Charge to the Front. Trail. Charge. As you were. Advance your Pikes. Muſqueteers take heed. Poize your Muſquets. Shoulder your Muſquets. Muſqueteers make ready.

Of the Exerciſe of the Pike and Muſquet together.

The Pikes being advanced, and the Muſquets ſhouldered, the Command is: [*Muſqueteers make ready.*]

Here the Muſqueteers are diſtinctly and orderly to perform every poſture of the *Muſquet* together, till they ſtand guarded with their Muſquets before them; and being ready, (*viz.* cockt) they are to bring up their Muſquets ſtrait before them, their left hands the height of their mouths, and with their thumbs on the Cocks, and their two fore fingers guarding the Pan. And the Pike-men at the ſame word of Command, [*make ready*:] are to bring their Pikes before them, to their *Recover*, their left hand to the height of their mouths; the butt-end of their Pikes in the palm of their hands, and are to charge as the Muſqueteers reſt their Arms, and face as the *Muſqueteers* face: and at the word charge, the *Muſqueteers* and Pike-men are to take care to bring down their Pikes and Muſquets together (very quick) at a convenient diſtance, and to bring them up ſtrait before them as quick, before they turn, to prevent claſhing: and whenever they recover their Arms before them, to bring their right heels to their left inſteps: and when the Pikes charge and the Muſquets reſt, to fall back with their right feet in a direct line. Then. *To the Right* (4 *times.*) Charge. *To the Right about*, Charge. *As you were.* Charge. *To the left* (4 *times.*) Charge. *To the left about.* Charge. *As you were.* Charge. *Recover your Arms. Half bend your Muſquets. Poize your Muſquets.*

quets. Shoulder your Muſquets. Here the Pike-men are to bring their Pikes from their Recover to their Advance. *Poize your Muſquets.* Here the Pike-men are to joyn their left hands to their Pikes even with their ſhoulders. Then, *Order your Arms.* In ordering their Arms they muſt be ſure to make a little ſtop before the butt-end comes to the ground, that they may come down altogether at once. *Pikes to your inſide Order. Lay down your Arms. Quit your Arms.* After laying down their Arms and quitting them, they are all to ſtand up together. *To the Right about.* March. When the Soldiers have laid down their Arms, and quitted them, upon beat of the Drum they are all to draw their Swords, and run to their Arms, obſerving always to keep the points of their Swords upright for fear of miſchief. When they lay their right hands on their Swords they muſt take hold off the Scabberd with their left hand. Then, *Return your Swords.* When they return their Swords, they muſt do it all at one motion. *Handle your Arms. Pikes to your outſide Order. Poize your Muſquets. Shoulder your Muſquets. Advance your Pikes.*

Officers, take your Poſts at the head of the Battalion. March. Here all the Officers are to march back in the ſame method to the Front of the Battalion as they went from it, *& per contra.*

Of Military Signs.

There are two Military ſenſes of Advertiſement, the Ear and the Eye. And every Soldier ought to be very carefull, that by ſilence he may the better hearken to all Commands: and that by the vigilancy of his Eye, he may obſerve every Sign

Sign that may be given. There are 3 ſigns uſed in War. Vocal. Semivocal. and a Mute.

Vocal is when the word of Command is heard by or given to the Ear of every Soldier.

Semivocal is that which is given by the Trumpet to the Cavalry, and by the Drum to the Infantry.

A Mute is by ſigns to the Eye, as by the motion of the Colours, or of the hand of the Commander.

It is very requiſite that every Soldier ſhould learn and underſtand all Military ſigns and directions; for experience hath taught that he that is negligent in either, may not only loſe himſelf but be the cauſe of the loſs of many others.

Of the Poſtures of the Pikes and Muſquets.

A Poſture is a mode or garb that we are uſed unto in the well handling of our Arms. And firſt of the Pike which in point of Antiquity and Honour craveth the precedency.

Directions for the Poſtures in exerciſing of the Pike.

It is the part of every young Soldier to learn and practiſe in the firſt place the Poſtures of handling his Arms, which muſt be done by endeavouring to ſet ſome time apart for the exerciſing and practiſe thereof.

1. *Silence* is an excellent Vertue, and ought in the firſt place to be commanded and moſt diligently obſerved.

And here obſerve for all; that in the Exerciſe both of Pike and Muſquet, the Feet are to be kept at a moderate diſtance; not too wide aſunder

der nor too near: And be ſure to keep your left heel faſt, and to ſet your feet exactly: Or elſe you will never exerciſe well.

Advance your Pikes. With your right hand lift upright your Pike as high as you can well reach, and take it with your left hand as low as you can, and raiſe it till the butt end comes into your right hand; then bring it between your Breaſt and Shoulder upright cloſe to your Thigh.

To the Front. Lay your left hand on your Pike even with the Top of your Shoulder, and bring the Pike ſtrait upright before you with a quick motion; drawing in your right heel to your left Inſtep.

Charge. Fall back with your right leg, ſo that the Heel of your left foot may be directly againſt the middle of your right foot: Bring down your Pike extreme quick with a jerk, and charge Breaſt high; your left Elbow under your Pike to ſupport it, always holding the butt end of your Pike in the Palm of your right hand, and your left foot pointing in a ſtrait line with your Pike.

To the right 4 times. Upon your left foot turn your Body to the right; follow the former directions and charge.

To the right about. Upon your left foot turn your Body to the right about; bringing your right Heel as before, and your Pike recovered charge as before.

As you were. This is but turning about the contrary way obſerving the ſame directions as before; remembring always to bring your Pike ſtrait up, and not to ſwing it about that ſo it may not clatter againſt the other Pikes.

To the left 4 times. } { *As you were.*
To the left about. } { *Advance your Pike.*

Uſe the Directions before given.

Shoulder. Your Pike advanced, lay your left hand on your Pike even with your Shoulder; fall back with your right Leg, and put back your right Arm as far as you well can, holding your Pike ½ a foot from your ſide; then taking off your left hand, bring up your right Leg and lay your Pike on your right Shoulder, your Elbow cloſe to your Body, the butt-end ½ a foot from the Ground.

Charge to the Front. Fall back with your right Leg, and put back your right Arm as far as you can, then with your left hand bring the butt-end of your Pike backwards, turning the head of it with your right hand; then forſaking it with that hand take hold of the butt-end and charge Breaſt high, directly forwards as before, *Vide* Charge.

Shoulder as you were. You muſt now raiſe your Pike with both your hands, then forſaking it with your right hand, and turning the head backwards with the left, take hold again with the right as high as you can reach with eaſe, bringing up your right Leg and forſaking your Pike with your left hand, Shoulder as before.

Charge to the right. Bring your Pike up, and turn the butt-end backwards by your right ſide, taking it in the Palm of your right hand, turning your Body to the right upon your left foot with your right Leg behind your left, and charge as before.

Shoulder as you were. Turn about to the left bringing your feet as formerly directed, then with your left hand turn the head of the Pike to the

the right; then taking hold of it with your right hand, hold it in both hands at a little diſtance from your Body as before, ſloped at the ſame height as when ſhouldered, then bringing up your right Leg, lay it on your Shoulder.

Charge to the right about. Fall back with your Leg and Hand as before, and ſtand with your Pike in the ſame poſture, then upon your left foot turn to the right about, bring the butt-end of your Pike to the right ſide falling back with your right Leg, level your Pike breaſt high, and charge.

As you were. Turn to the left about with your left hand, bring the butt-end of your Pike by your left ſide, keeping the Speer-point exactly to the Reer, the ſame height as before, then laying your right hand as high as you can well reach, hold it from your Body as before, then bring up your right Leg and Shoulder.

Charge to the left. Fall back with your Leg and Arm as in the reſt, and turn to the left, and with your left hand turn the butt-end of the Pike to the right, and bring up your right Leg, Charge.

As you were. Raiſe the Spear of your Pike with both hands, turn to the right, and fall back with your right Leg and Arm, the Spear directly to the Reer, holding your Pike as before from your ſide, bring up your right Leg and Shoulder.

Charge to the left about. Fall back with Leg and Hand as before, then with both hands bring the Pike over your head, keeping the Spear directly to the Reer, neither higher nor lower than when ſhouldered, then turning to the left about charge; as before.

As

As you were. Bring your Pike over your head with your left hand, falling back with your right Leg, and putting back your right Arm as before, bring up your right Leg and Shoulder.

Port. As charging to the Front only, you muſt not hold your Pike too low; and inſtead of reſting it upon your left Elbow, now you muſt reſt it between the Thumb and Forefinger with your Elbow cloſe to your ſide.

Comport. Bring your left hand back, and ſtretch out the right as far as you can, at the ſame time graſp your Pike with your right hand, then leaving it with your left hand, fall back with your right Leg even with your left, cloſe the Pike to your ſide, the Spear of your Pike about the height of your head.

Charge to the Front. Extend your right Arm as far as you can, advancing your right Leg at the ſame motion, and putting your left hand as far back as you can bring forward your Pike; then ſtepping back with your right Leg, take hold of the butt-end of it with your right hand and charge.

Trail. Face to the right about, and let the Spear of your Pike fall behind you; quit your right hand from the butt-end of it without ſtirring your left.

Charge as you were. Turn to the left about, and taking the butt-end of the Pike on the Palm of your right hand; charge as before.

Advance your Pikes. Bring up your right heel to your left Inſtep, and your Pike before you to the Recover; then bring your right foot even with your left, and your Pike to your right Thigh.

Order your Pikes. Lay your left hand on your Pike even with the Top of your Shoulder, then ſink-

ſinking your left hand take hold of it with your right hand ſo, as when the butt end of it is upon the Ground your right hand may be againſt your Eye, keeping your Pike near your head, and the but-end near the Latchet of your Shoe.

Pikes to your inſide Order. Move the butt-end of your Pike on the inſide of the middle of your right foot.

Lay down your Pike. Step forward quick with your left Leg, lay it down ſtrait with your right hand.

Quit your Pikes. Bring back your left Leg even to your right, and ſtand up all together.

Handle your Pikes. Step forward with your left Leg quick, placing the middle of your right foot againſt the butt-end of your Pike, lay your right hand on your Pike as far as you can reach.

Order your Pikes. Raiſe the Pike with your right hand only, and fall back with your left Leg.

Pikes to your outſide Order. Place the butt-end of your Pike at the middle, on the outſide of your Foot. *Advance,* As before.

Directions for the Poſtures in exerciſing the Fire-lock Muſquet.

Lay your right hand on your Muſquet. Turn the Barrel towards you, the lock uppermoſt, and lay your right hand juſt behind the lock, put the butt-end of your Muſquet to your Shoulder.

Poize your Muſquet. Graſp your Muſquet hard juſt behind the lock, facing to the right with a quick motion upon your left Heel. Bring your Muſquet directly before you the height of your Cravat, reſting your right Elbow on your right ſide, your left Heel being exactly againſt the middle of your right foot.

Reſt

Reſt your Muſquet. Let your Muſquet ſink down to your left hand, and receive the Muſquet into it, juſt where the Scowrer enters into the Stock, not toutching the barrel; keeping your right hand upon your Muſquet, behind the lock, let your Muſquet be held a little ſloping, about ½ a foot from your ſide, as low as you can, without ſtooping.

Cock your Muſquet. Put your right Thumb upon the Cock, and your Fingers behind the Trigger, and bringing your Muſquet cloſe to your Thigh, cock it.

Guard your Muſquet. Your Muſquet reſted, your thumb upon the lock, and your fingers behind the trigger, bring up your Muſquet with a quick motion, ſtreight before you to your Recover, keeping your left hand as high as your mouth, and about ½ a foot from it, without ſtooping, bringing your right heel to your left inſtep.

Preſent. Fall back with your right foot, ſo that the left heel be againſt the middle of it, raiſing the butt-end of your Muſquet to your right Shoulder, your right Elbow not higher than your Piece, bending your left Knee, and keeping the right very ſtiff, and your Muſquet being levelled breaſt high with your fingers upon the trigger.

Fire. Then draw the trigger at one motion, keeping the body ſteddy, taking good aim, and keeping the Muſquet faſt to your Shoulder, until you have the Word of Command

Recover your Armes. Sink the butt-end of your Muſquet, till you hold it upright in both hands, the left hand always as high as your mouth, and the right under the lock, bringing up your Muſquet with a very quick motion, and your right heel to your left inſtep.

Half bend you Muſquet. Falling back with your right leg, bring your Muſquet to the Reſt, laying your right thumb upon the lock, and your fingers behind the trigger, half bend it, by putting it cloſe to your thigh, and then keeping your Muſquet reſted.

Clean your Pan. Wipe your Pan by preſſing the ball of your thumb into it, then holding your Muſquet in your right hand behind the lock.

Handle your Primer. Take hold of the great end of it, between the thumb and fore-finger of your left hand, your Arm backwards.

Prime. Holding your Muſquet exactly level, put powder into your Pan, keeping your left foot directly to the front.

Shut your Pan. With your two firſt fingers, and caſting back your Primer, bring your Muſquet to the Recover, as there directed : Keeping your thumb on the top of the ſteel.

Blow off your looſe Corns. Bring your Pan up to your mouth, ſtanding upright, and at one ſtrong blaſt, blow off the looſe Corns, then letting your Muſquet ſink into the poſture it was in before.

Caſt about to Charge. Advance with your right leg, turning your Muſquet the barrel downwards, bringing it to your left ſide, a little backwards in your left hand ; keeping your right foot Toe directly to the front, and your right heel over againſt the middle of the left foot, ballancing your Muſquet in your left hand, the right hand joyned to the Muzzel, which muſt be held directly to the front a foot from your body.

Handle your Charger. Take it full in your hand, and place it underneath your Muſquet, about an Inch from the Muzzel.

Open

Open it with your Teeth. Bring it up to your mouth, ſtanding upright with your head, then bring your Charger to the Muzzel of your Piece, as before, and cover the mouth of your Charger with the ball of your thumb.

Charge with Powder. Put the Charger of Powder into the barrel, holding your Charger again under your Muſquet as before.

Draw forth your Scowrer. Now let fall your Charger, and draw out the Scowrer at three motions, then hold it level the height of your Eye, your Arm extended.

Shorten it to an Inch. Turn the great end of your Scowrer towards you, and ſlip your hand till it comes to an inch of the end; letting it reſt in a ſtreight line below your right Breaſt.

Charge with Bullet. Take the Bullet out of your mouth putting it into the Barrel, and then put the great end of the Scowrer after it into the Muzzel of the Piece, and ſo ſtand.

Ram down Powder and Ball. Which is done by holding a handfull of the Scowrer in your hand, and your thumb on the top of it.

Withdraw your Scowrer. Turn the fore part of your hand towards the Muzzel, and at three motions draw the Scowrer, and hold or dart it, as before.

Shorten it to a handfull. Turn the ſmall end of your Scowrer to your Breaſt and ſlip your hand till it comes within a handfull of the end, and hold it as before directed.

Return your Scowrer. Put it in the Stock of your Muſquet, preſſing it down with your thumb, then always remember to graſp the Muzzel of your Muſquet with your right hand, your thumb ſtrait out upon the Scowrer, and your Muſquet

clear from your ſide about ½ a foot, and to keep the Muzzels all of a height directly to the front.

Poize your Muſquet. With your left hand bring up your Muſquet before you, and falling with your right leg even to your left, graſp your Muſquet under the lock with your right hand, and poize, as before.

Shoulder your Muſquet. } { *Poize.*
As formerly. } { *As before.*

Order. Sink your right hand a little, take hold of the Stock with your left hand near the end of the Stock; then ſinking that hand, take hold with your right hand an inch below the Muzzel, and let the butt-end ſink to the ground, cloſe to your right foot, the lock outwards.

Lay down your Muſquet. Turn your Muſquet with the lock upwards, and ſtep forwards with your left leg, and right hand, and lay it upon the ground in a ſtrait line.

Quit your Muſquet. Fall back with your left leg, even to your right, and ſtand up.

Handle your Muſquet. Step forwards with your left leg, and lay your right hand near the Muzzel of your Muſquet.

Order your Muſquet. Lift up the Muzzel of your Muſquet, and fall back with your left leg, even to your right, turning the lock of your Muſquet outwards, by the middle of your foot.

Directions for the Poſtures in exerciſing the Match-lock-Muſquet.

Lay down your Matches. This is to be done at four motions, *Viz.* 1ſt. Turn the butt-end of your Muſqueta little, ſlipping it as it lies on your Shoulder, and lay your right hand on your Match.

2ly. Extend

2ly. Extend your right hand, and foot before you, turning the Muſquet again into its place 3ly. You muſt ſtoop, bending the left ham, bringing the Match nearer your right foot, with in ſide. 4ly. Quit it, and ſtand up, bringing your right foot even to the left. *Lay your right hand on your Muſquets. Poize your Muſquets. Reſt your Muſquets.* As in the Exerciſe of the Fire-lock.

Handle your Match. Take your Match from between your third and fourth fingers, with your thumb and firſt finger of your right hand; the palm turned from you, your right Arm extended towards your right hand man.

Blow your Match. Bring up the Match to your mouth, turning your head a little to the right without ſtooping, and blow a ſtrong blaſt.

Cock and try your Match. Bring your Match with a compaſs about to the Cock, and preſs it down with your Thumb, ſtaying it with your two next fingers; then pull down your Cock to the Pan, and ſo raiſe or ſink your Match, that it may fall juſt in the middle of the Pan.

Guard your Pan. Bring up your Muſquet ſtrait upright before you, the Pan even with your mouth, and about ½ a foot from before it, then lay your two firſt fingers upon the Pan, and your thumb behind it, and your right heel to your left Inſtep.

Blow your Match. As before, and keep your Muſquet at that height.

Preſent and open your Pan. Raiſe the butt-end of your Muſquet to your Shoulder, keeping your fingers upon the Pan, then bring your hand back to the Trigger. And obſerve the Directions as in the Fire-lock.

Fire. Recover your Armes. As in the Fire lock.

Return your Match. Hold your Muſquet in your left hand, the Barrel towards you, your left Elbow reſting on your Body: Take your match between your thumb and fore-finger of the right hand, your thumb on the top of it, turning the palm of your hand from you, take one end of the match between the third and fourth finger of your left hand, and the other end between the firſt and ſecond finger, and then lay your right hand under the Pan of your Muſquet.

Clean your Pan. Wipe your Pan hard with the ball of your thumb, falling back with your right leg, reſt your Muſquet, lay your right hand again behind the Pan on the notch of your Muſquet.

Handle your Primer. Prime. As the Fire-lock.

Shut your Pan. With the palm of your hand: At this Command, caſting back your Primer, bring up your right heel to your left inſtep, and your Muſquet ſtrait up before you; your left hand the height of your mouth, and your right hand under the Pan.

Blow off your looſe Corns. Caſt about to Charge. Handle your Charger. Open it with your Teeth. Charge with Powder. Draw forth your Scowrer. Shorten it to an Inch. Charge with Bullet. Ram down Powder and Ball. Withdraw your Scowrer. Shorten it to a Handfull. Return your Scowrer.

Theſe as in the Fire-lock. *Poize your Muſquet. Shoulder your Muſquet. Poize your Muſquet* (as before.)

Order your Muſquet. Sink your right hand a little, take hold of the Stock where the Scowrer goes into it with the left hand; then ſinking that hand, take hold of the muzzel with your right hand, and let the butt-end ſink eaſily to the ground,

ground, the Butt-end close to your right foot, about the middle of it, your right hand an Inch from the muzzel, and your thumb strait up to it, the Barrel of the Musquet backward, and your match at one end between the first and second finger of your left hand, the other end between the third and fourth finger, a large inch from the Cole.

The Exercise of the Pikes is to be the same with the Pikes and Fire-locks.

Exercise of the Granadeers on foot.

These are to draw up in Rank and File, in the same Order as the Musqueteers, onely three deep; and being shouldered the command is, *Lay your right hand on your Fire-lock. Poize your Fire-lock. Rest your Fire-lock. Cock your Fire-lock. Guard your Fire-lock. Present. Fire. Recover your Arms.* As in the Exercise of the Musqueteers. *Cast over to the left.* Then they are to lay their right hand on their Daggers. *Draw your Dagger.* Here they must hold it fast upright before them. *Screw it into the muzzel of your Fire-lock. Recover your Armes. Charge. To the Right* (4 *times*) *Charge. To the Right about, Charge. As you were: Charge. To the left* (4 *times*) *Charge. To the left about, Charge. As you were: Charge. Recover your Armes.* This is to be done with a quick motion, seizing the Fire-lock under the Lock with their right hand. *Cast over to the left.* Here they are to lay hold of their Daggers with their right hand. *Withdraw your Dagger.* Hold your Dagger before you with the flat side towards you. *Return your Dagger. Poize your Fire lock. Half bend your Fire-lock. Clean your Pan.* As the Musqueteers. *Open your Cartridg-Box. Handle your Primer. Prime.*

Return your Primer. Shut your Pan. Blow off your looſe Corns. Caſt about to charge. Handle your Cartridg. Open it with your Teeth. Charge with Powder and Ball. Draw forth your Scowrer. Shorten it to an Inch. Here you are to put it into the muzzel of the Fire-lock, and hold it there. *Ram down Powder and Ball. Withdraw your Scowrer. Shorten it to a Handfull. Return your Scowrer. Poize your Fire-lock.* As the Muſqueteers. *Shoulder your Fire-lock.* Here the Ranks are to cloſe forwards to ſix foot. *Poize your Fire-lock. Sling your Fire-lock.* That is, take hold of the ſling with the left hand.

Handle your Pouch. With your left hand on the bottom of it, the right leg advanced, and your right hands all of a height. *Open your Pouch. Take forth your Granade.* Here the right hand muſt be extended before you. *Shut your Pouch*; at once. *Uncaſe your Fuſe.* Fall back with your right foot even to the left, and face. *Handle your match.* The 3 Ranks altogether. *Blow your match.* The firſt Rank onely falling back with the right Leg. *Fire your Fuſe. Deliver your Granade.* Here the ſecond Rank is to march ſix foot before the firſt, with their matches ready to blow. *Blow your match. Fire your Fuſe. Deliver your Granade.* Here the third Ranks do as the ſecond did. *Blow your match.* Now the other Ranks are to lay their left hand on their Hatchets. *Fire your Fuſe.* Here they muſt raiſe their Hatchets.

Deliver your Granade. Here the Serjeants are to take care that the firſt Rank ſtand, the ſecond march ſix foot before the firſt, and the third ſix foot before the ſecond, all with their Hatchets raiſed expecting the word of command: [*Fall on.*] Stepping forward with the left Leg.

Reco-

Recover your Hatchet. As in the handling it, return your Hatchet into the Frog of the Belt. *Poize your Fire-lock. Shoulder your Fire-lock.* As the Muſqueteers.

Granadeers make ready. Here the firſt Rank make ready their Fire-locks, the ſecond Rank handle their Pouch, and the third Rank their Hatchets. *The firſt Rank preſent.* Now the ſecond Rank is to open their pouch, and take forth their Granade; and the third raiſe their Hatchets. *Fire.* Here the ſecond Rank are to ſhut their pouch, and uncaſe their Fuſe, and handle their match. *Recover your Armes.* Here without any word of command, the firſt Rank are to caſt over to the left: Draw their Dagger, ſcrew it into the muzzel of their Fire-lock, Recover their Armes, and charge, the ſecond Rank to march ſix foot before them.

Blow your Match. Fire your Fuſe. Deliver your Granade. Here they muſt poize their Fire-locks, and make ready, and the third rank as the ſecond with their Hatchets. *Fall on. Recover your Hatchets. Recover your Hatchets.* Now the third rank is to march 12 foot before the firſt, charging the ſecond to ſix foot, and the firſt return their Hatchets, and make ready their Fire-locks. *Recover your Armes.* Here they half bend their Fire locks. *Caſt over to the left. Withdraw your Dagger. Return your Dagger. Poize your Fire-lock. Shoulder your Fire-lock:* Theſe as before.

Face to the Right about. March. Here the Officers are to take care that the Ranks open to 12 foot, and continue marching till they come to their ground, and there to halt without any command: *As you were.*

Poize

Poize your Fire-lock. } { *Lay down your Armes.*
Order your Armes. } { *Quit your Armes.*

Face to the Right about. As the Muſqueteers: *March.* Being clear of their Armes, upon beat of Drum they muſt run to their Armes with an Huzza, their Daggers drawn, and their points upwards.

Return your Daggers. } { *Poize your Fire-lock.*
Handle your Armes. } { *Shoulder your Fire-lock.*
Order your Armes. } { As the Muſqueteers.

Of the Exerciſe of the Horſe.

When a Troop or Squadron are to exerciſe, their Carabines and Piſtols being charged, and the Corporals having ſeen that all are ready, the chief Officer commands ſilence: and then,

Lay your right hands upon your right Swords. Draw your Swords. Put your Swords into your Bridle hands. Lay your hands on your Piſtols. Draw your Piſtols. Cock your Piſtols. Hold up your hands. Give Fire. Then keep up their hands till the word of Command be given. [*Return your Piſtols.*]

The ſame words of command are given for the other Piſtol, and then the words of Command are, *Lay your hands on your Carabines. Advance your Carabines. Cock your Carabines. Preſent your Carabines. Fire. Let fall your Carabines. Take your Swords from your Bridle hands. Return your Swords.*

Theſe are the chief motions which the Officers are to take care that they be exactly performed; onely here note, that there is an alteration made in the manner of wheeling of Horſe: The practiſe now is, when a Squadron of Horſe is commanded to wheel to the right; that the right hand men keep their ground, onely turning their Horſes head to the right, whiles the left comes about, whereas

whereas formerly the right hand men closed to the left; by which the Ranks were apt to be put out of order.

The Exercise of Granadeers on Horse-back.

Granadeers have a care. Sling your Musquets. Put on your Caps. Right and left hand men of each Rank keep mounted. Clear your right foot of the Stirrup. Here they must handle their Musquets, and cast them backwards over their Cloaks. *Dismount altogether. Make ready your Links. Link your Horses to the left. March clear of your Horses.* Here the second or third Rank marching through, and when clear handling their Musquets, *Shoulder your Musquets.* Which is to be done marching, and here the Officers are to take care of the Ranks, and that the Files open three foot distance in the marching. *Halt. Lay your right hand on your Musquet. Poize your Musquet facing to the right. Rest your Musquet. Cock and Guard. Present. Fire. Recover your Armes.* By half bending your Musquets. *Cast about to the left. Draw your Daggers. Fix them in your Musquet. Recover your Armes. Charge to the Front. To the Right, Charge (4 times.) As you were. To the left, Charge (4 times.) To the left about. As you were. Recover your Armes. Cast about to the left.* Here the right hand must be on your Dagger. *Withdraw your Dagger. Return your Dagger. Poize your Musquet. Clean your Pan. Open your Cartridg-Box. Take out your Primer. Prime. Return your Primer. Shut your Pan:* Bringing your Musquet up quick before you. *Blow off your loose Corns. Cast about to charge. Take out your Cartridg.* Quickly shutting the Box, uncap your Cartridg with your Teeth. *Load with Powder and Ball. Draw forth your*

your Scowrer. Shorten it to an Inch. Place it in the Barrel. Ram home Powder and Ball. Withdraw your Scowrer. Shorten it to a Handfull. Return your Scowrer. Poize your Muſquet. Before you. *Shoulder your Muſquet, Poize your Muſquet,* laying hold of the Slings with your left hands. *Sling your Muſquets. Handle your Pouch.* Stepping forwards with your right Leg, your left hand at the bottom, and your right held up all of a height.

Open your Pouch. Take forth your Granade. Shut your Pouch. Altogether at one motion. *Uncaſe your Fuſe.* Falling back with your right Leg, even to your left, and facing to the Front.

Handle your match. The three Ranks doing it together. *Blow your match.* The firſt Rank only falling back with the right Leg. *The firſt Rank fire your Fuſe. Deliver your Granade.* Then unſling your Muſquets. Now the ſecond Rank is to march through on the right, ſix foot before the firſt, with their matches ready to blow. *Blow your Match. Fire your Fuſe. Deliver your Granade.* Here they muſt unſling, and ſtand cockt and guarded; and the third Rank is to march through on the right, ſix foot before the ſecond. *Blow your Match. Fire your Fuſe. Deliver you Granade.* Here as before: And the firſt Front is to march through ſix foot. *Firſt Rank preſent. Fire.* Here the Daggers, are to be fixed in their muſquets, and the ſecond and third Ranks are to perform in the ſame manner, one after the other, by the ſame words of Command. *Recover your Armes. Caſt about to the left. Withdraw your Daggers. Return your Daggers. Poize your Muſquets.* To the proper Front. *Shoulder your Muſquets. To the Right about.* Taking up your firſt ground, and opening

opening your Ranks in your march. *To your Leaders. Poize your Muſquets. Reſt upon your Armes. Lay down your Armes. To the Right about: March.* Breaking their Ranks, then the Drum beating, they draw their Swords, facing to the left about, running with a *Huzza* to their Armes. *Return your Swords. Handle your Armes. Recover and Poize. Shoulder your Muſquets. Poize your Muſquets. Face to the Right about. Sling your Muſquets. March to your Horſes.* The ſecond and third marching and ſtanding at their Horſe's head facing to the Front. *Unlink your Horſes. Faſten your Links.* Here ſhorten your Bridles: *Put your foot in your Sirrup.* Laying their Muſquets over their Saddles. *Mount. Handle your Swords. Draw your Swords. Place your Swords.* In your Bridle hand. *Handle your Piſtol,* which is always the left firſt. *Draw your Piſtol. Cock your Piſtol.* Keeping your Thumb on the Cock. *Preſent.* The Cock as high as your head in exerciſing. *Fire.* Still holding it up till the next word of Command. *Return your Piſtol.* The ſame for the right Piſtol. *Handle your Muſquet. Unſling your Muſquet. Mount your Muſquet.* Here you may order the Muſquets to be charged, and then command: *Cock your Muſquets. Preſent your Muſquets Sling your Muſquets. Into the Air. Give fire.* Keeping the Muzzel till the next word of Command: *Sling your Muſquets. Handle your Swords.* Taking them in your right hand; *March.*

Exerciſe of Dragoons.

Suppoſing the Dragoons drawn up in three Ranks, with their Muſquets advanced, and *ſilence* commanded; the word is: *Dragoons have a care, ſling your Muſquets, make ready your Links, clear your right foot of your Stirrup, diſmount.* Standing

ing at your Horſe's head, here the ſix out-ſide men are to continue mounted, that they may take care of the Horſes. *Link your Horſes, to the left, march clear of your Horſes, and ſhoulder as you march. Halt.* Here the Battalion is to be formed in the ſame method as the foot. Which is done by theſe words of Command: *Have a care of the Exerciſe. Officers to the Right about. Take your Poſt in the Reer of the Battalion:* Here the Serjeants and Corporals falls into the Flank and Reer of the Battalion, and the Commiſſion Officers forms a Rank in the Reer. *Dragoons have a care.* Here they are to pull off their Right hand gloves, and place them under their Girdles. *Lay your right hand to your Muſquet. Poize your Muſquet. Reſt your Muſquet. Cock and Guard. Preſent. Fire. Recover your Armes with the Cock half bent. Reſt upon your Muſquet. Handle your Dagger. Draw forth your Dagger. Fix them in the muzzel of your Muſquets. Charge to the Front. To the right (4 times) charge. To tke right about, charge. To the left about, charge. To the left (4 times) Charge. To the left about, charge. To the right about, charge. Recover your Armes. Reſt upon your Muſquets. Handle your Dagger. Withdraw your Dagger. Place your Dagger. Poize your Muſquet. Reſt your Muſquet. Clean the Pan. Open your Cartridg-Box. Handle your Primer. Draw forth your Primer. Sink and Prime. Return your Primer. Shut your Pan with your two Fore-fingers. Blow off your looſe Corns:* At the ſame time recovering your Armes, *Caſt about to charge. Handle your Cartridg. Take out your Cartridg,* as the Granadeers, *Open it with your Teeth. Charge with Powder and Ball. Draw forth your Scowrer. Shorten it to an Inch,* againſt your right Breaſt: *Put it in the muzzel of your Muſquet; Ram down Powder and Ball. With-*

Withdraw your Scowrer, ſhorten it to a handfull as before. *Place your Scowrer. Poize your muſquets. Shoulder your Muſquets. Poize your Muſquets. Reſt upon your Armes. Lay down your Armes. Quit your Armes. To the right about. March clear of your Armes, and Breek.* At beat of Drum they are to return to their Armes with an *Huzza*, and as they run, draw their Swords, and every man is to ſtand over his own Armes. *Return your Swords. Handle your Armes. Reſt upon your Armes. Poize your Muſquets. Sling your Muſquets. To the right about. March to your Horſes. Unlink your Horſes. Shorten your Bridles. Put your left foot in the Stirrup. Mount. Faſten your Links. Unſling and Advance your Muſquets.*

Of Doublings.

Doublings are neceſſary and uſefull for the ſtrengthening any part of a Battel, as occaſion ſhall require: And conſiſt in theſe two Generals.

1. Doublings of Length } { Front and Reer.
2. Doublings of Depth. } { Both Flanks.

There are ſix ſorts of Doublings, *Viz.*

1. Of Ranks, when every Rank doubles into the odd, and if the odd Ranks are to double, Face the Body to the Reer, and the ſame word of command will perform it.
2. Half Files. } Are ſaid to be doubled when
3. Bringers up. } they ſhall double their Ranks into the Front.
4. The doubling of the Reer, is when the half File doubles the Reer.

5. The

5. The Doubling of Files, is when even Files double into the odd.

6. The doubling of half Ranks, is when one Rank ſhall double the other.

All Doublings are performed by,
- Paſſing through.
- Counter Marches.
- Intire or Diviſional Doublings.

In the Doubling of Ranks, obſerve, that the Doubling of Files reduce them; ſo in the doubling of Files to any hand, the doubling of Ranks to the contrary hand, reduceth them alſo.

In all motions of doubling, obſerve, that they that are to double before they move from their places, are to advance, and poize their Armes; and when they have performed their Commands, they are immediately to conform to the ſame Poſture, that thoſe whom they double are in, whether it be at ſhoulder or advance.

All motions are performed in three ſteps, and firſt by ſtepping forth of the foot, which is next to the hand named; and for reducement to return by the contrary hand.

All intire Doublings are to be performed by Order, both in Rank and File, and all diviſional Doublings, are to be at open order both in Rank and File, and in all motions obſerve your right hand man.

A Battallion may be ſtrengthened by Doublings either in the Front, Reer or Flanks.

The Front and Reer may be ſtrengthened by,
- Intire Doublings.
- Intire Wheelings.
- Diviſional Doublings.
- Diviſional Wheelings.

The

The Flanks are strengthened or doubled, by { Files. Half Ranks. Diviſion. Wheelings.

The Commands are, *Ranks to the right, double; march. Ranks as you were; march. Ranks to the left, double; march. Ranks as you were, march.*

Here obſerve as for a general rule, upon all Doublings of Ranks or half Files; that though they are to turn to the contrary hand they doubled on, from the ground they doubled to; yet when they come to their own ground, they are always to turn to the hand they doubled on, which brings them directly after their Leaders.

The doubling of Files is performed in the ſame manner, and is the ſame thing with the reduction of doubled Ranks.

For doubling of Front half Files by the Reer, half Files with the Reduction, command. *Reer half Files to the right hand, double your Front; march.*

Reer half Files, as you were; march. Reer half Files to the left hand, double your Front; march. Reer half Files, as you were; march.

And for reduction let the Reer half Files without facing about ſtand, till the Front half Files have paſſed by, and then fall after their proper Leaders.

But if the Front half Files are to be doubled by the Reer, the Body ſtanding ſtill, the Reer half Files are to march extreme ſlow, and to obſerve well their right hand men.

For doubling of Reer half Files by the Front, half Files with the Reduction.

Command, *Front half Files, to the right about, double your Reer half Files; march.*

Here the 3 front Ranks or front half Files, turn to the right about, paſſing on the right hand of the Reer half Files, and double into them, and then to face to the left about to their Leader, without any word of command. *Reduction. Front half Files*, as you were, *march.*

Here the front half Files are to march ſlowly, keeping three foot from the right hand men, inclining towards the left, which brings them directly to their former Ground.

Plate II.

The manner of exerciſing Doublings.

The Battalion being drawn up, if it be of Muſqueteers onely, the Officer who exerciſes, gives the word of command, *Muſqueteers, ſhoulder your Muſquets.* If it be a Battalion of ſimple Pikes, the Officer commands thoſe that are to march to advance their Pikes, in theſe words, *Ranks that are to double to the Right, advance your Pikes. Ranks that are to double to the Left, advance your Pikes.* And this is a general Rule in a Battalion of Pikes, that always they who are to double advance their Pikes, and when they make a ſtand they fix their Pike upon the Ground.

But when the Battalion is compos'd of Muſqueteers onely, the Officer gives the word of command, according to the uſual Practiſe for Muſqueteers alone, and Pikes alone.

To the right, double your Ranks in Front: March. To make your Doubling true, it is requiſite, that the Souldiers parting from the left Foot, come to place themſelves in the middle of the Diſtances of the Ranks which they double: Example A, as it is mark'd with little Points. If the Battalion be

of

of ſix Ranks in depth, when they ſhall double by Ranks, either in Front or in Reer; the Battalion ſhall looſe one Rank of the depth of the Ground, and the Diſtances of the Ranks ſhall become double with thoſe, with which they were double before.

To reduce your Battalion to its firſt Eſtate, you need no more than ſay thus, *Ranks as you were*; and to double to the left, ſay no more than this, *To the Left, double your Ranks.*

To double your Ranks by half Files, you muſt ſay, *To the Right by half Files double your Ranks in Front: March.* You muſt give the ſame word of command to double to the left, by half Files upon the Wings, or in the Reer: Example B, to reduce your Battalion, you need ſay no more than this, *Ranks as you were.*

If you would have your Battalion double their Ranks in Front upon the Wings, it is requiſite that from the half File to the cloſe File, the Battalion cut it ſelf in the half Rank, and that the half Rank on the left hand, face to the left, and that they double upon the Wings of the two, that have not ſtirr'd from their Ground: Example C.

This doubling ſerves to enlarge the Front, and to prevent being ſurrounded, when you fear to be aſſaulted in Flank.

Plate III.

Of Wheeling.

Wheeling is a Military motion which cauſes the Head of the Battalion, to turn on that ſide where the Flank ſtood, which is ſerviceable when the Enemy attacks the Wing of the Battalion; or when you would attack the Enemy

himſelf in Flank. And as there is often a neceſſity in War to make or repell theſe ſorts of Attacks, wheeling is a motion very neceſſary, which is thus perform'd.

The Battalion being drawn up as is mark'd A, the Officer gives the word of commnad, *March.* When the Battalion wheels upon the firſt head of the right hand File, it wheels to the right, when upon the firſt head of the left hand File, to the left. A Quarter wheeling is call'd the firſt wheeling as when the Battalion A comes to poſſeſs the place of the Battalion B, it wheels upon the Center E. A half wheeling, is call'd the ſecond wheeling, which ſhall be performed when the Battalion poſſeſſes the Ground C. A Three Quarter wheeling, is call'd the third wheeling, when the Battalion wheels into the Ground D.

For better underſtanding of this, the Battalion A repreſents a Body ready to wheel, and the Battalion B repreſents a Body that has wheel'd.

The right Wing FH moves firſt, and in marching deſcribes the grand fourth part of the Circles repreſented in the figure, and comes to range it ſelf upon the correſponding right Wing mark'd with LG, ſo that all that Rank of men of the head of the File of the Battalion, comes to place it ſelf upon the Rank EG of the Battalion B, and the left Wing ER makes onely little Quarters of a Circle, as the figure ſhews; to place it ſelf upon the correſponding Line EG.

The Souldier who ſtands at the Angle E never moves from his Ground, but onely moves to the right, ſo that he is as it were the Center about which all the reſt of the Souldiers wheel. And every Souldier makes greater or leſſer Quarters of Circles, as they are more or leſs diſtant from

the

the Center E. Thus the Souldier O makes the leſſer Quarter of Circle OP. The Souldier V the Quarter of a Circle VT; and ſo of the reſt.

Obſerve that to make this wheeling truly, that the Serjeants are always to keep themſelves upon the Wings, that all the Souldiers may march with an equal pace.

Of Wheelings.

Before you enter upon Wheelings obſerve,

1. To cloſe your Ranks and Files to your Order.

2. That in wheeling you always keep a due diſtance to your Leader, obſerving your right and left hand man.

3. That ſuch care and moderation be uſed in the motions, that the contrary Flank be not forced by running to diſorder themſelves.

4. That your Armes be of a like poſture, *viz.* if the Muſquets be poized, the Pikes are to be advanced.

When a Battalion is to wheel to alter the Front either to one hand or the other, or to bring the Front where the Reer was, the command is, *Wheel to the right or left*; if to the right, the command is, *Wheel to the right*; *march.* Then every man in the Battalion moves, and wheels from the left to the right; onely he on the right Angle turns very ſlowly, being the hinge on which the reſt moves, but all the reſt the further they are from him, the ſwifter muſt their motion be; and every man muſt be carefull to obſerve, what diſtance he is at in the File when commanded to wheel, and to keep that ſame diſtance from his right or left hand man. And the ſame method is to be obſerved to the right, if the Battalion be commanded to wheel to the left.

Of

Of Wheeling when a Battalion or a Body of Men march in Diviſion.

Wheel to the right. Here the right hand man keeps his ground, and onely turns upon his heel, but the left hand man moves about quick, untill he makes an even line with his right hand man, and the Officer bids him ſtand, and the ſecond Rank muſt not begin to wheel till they have taken the ground of the firſt, and ſo every Rank ſucceſſively is to march directly forwards up to their Leader's ground before they begin to wheel.

Of Wheeling by ſingle Ranks.

Ranks to the right or left hand wheel; march.

If to the right, the right hand man of every Rank is to ſtand, and onely turn to the right on the ground he hands on; and the reſt are all to wheel together into one Rank at the word of command; *march.* The Reduction is, *Form your Ranks to the left*; or, *as ye were:* In the performance whereof, the left hand man of every Rank is to ſtand, and onely turn to the left; and at the word, *march*, the reſt are to wheel into their places as they were.

Of Wheeling backwards by half Ranks.

The number of men ought to be even in every Rank, and the right and left hand man of every Rank being ordered to ſtand, and to turn to the right and left inwards: The word of command is, *By half Ranks wheel to the right and left backward, march.*

At which words the half Ranks ſeparate, and fall back to the right and left hand men, making two

two Ranks oppoſite to one another: The Officers and Colours are to ſeparate according, and to take their Poſts. The Serjeants and Drums are to be on the right and left, the Reduction is, by half Ranks, *To the right and left inward, form your Ranks*, as you were, *march*. Here the right and left hand man of every Rank is to ſtand, and onely turn to the right and left inward, and the reſt at the word, *march*, are to wheel, and they will be in the ſame marching order, as they were. Fig. 3.

Of Countermarches.

Theſe of all motions in this Art, being the leaſt uſefull to our lateſt mode of Diſcipline, though of great Antiquity and uſed by the *Grecians*, I ſhall be ſhort in explaining of them, the knowledge of them being no burden.

All Countermarches ly under theſe 3 Heads.

1	Maintaining	of ground,	And are called	*Chorean*, or *Cretan*.
2	Looſing			*Lacedæmonian*.
3	Gaining			*Macedonian*.

In all which there is Counter marches of	Files.	When every Souldier ſhall follow his	Leader.
	Ranks.		Rank-man.
	Fronts.		File-leader.
	Reer Half-Files.		Bringer-up.
	Half Ranks.		Outſide-men.

1. All theſe may be performed by intire or diviſional Countermarches: In the Execution hereof your diſtance is to be, at ſix Foot of Rank and File.

2. When you are to countermarch to the right, the File Leaders are to ſtep forwards with their right Legs, and face about to the right, paſſing down to their Reer, with their reſpective File following them, obſerving their right and left hand man, and muſt not turn before they are advanced to their File-leaders.

3. All intire Countermarches of Files or Ranks may be reduced by contrary Countermarches: If the Command be to the right, reduce them to the left: And ſo for the Countermarches of the Front, Reer or Flanks, into the midſt reduce them back from the midſt.

Plate IV.

How to form and order Battalions.

The Art of forming Battalions inſtructs how to draw up a Body of Infantry in ſuch order, and with ſo much caution before hand, that it may be able advantageouſly to withſtand, and engage another Body of Infantry, though ſuperiour in number; or a Body of Horſe alone, or elſe a Body compos'd both of Horſe and Foot, when attack'd in an open Field, where there are neither Hedges nor Ditches, nor any riſing grounds to defend them from the Enemy. Now in regard the Pike and Partiſan are the onely Arms proper to ſtop the fury of the Cavalry, and to prevent their breaking in upon the Battalion, the firſt thing that is to be done in drawing up this Battalion muſt be to form a Body of all Pikes, and it muſt be the chief care of the Officer that commands the Party, to diſpoſe his men in ſuch a manner, that they may not defend the Muſqueteers, but alſo the Colours and the Baggage, if there be occaſion.

Now

Now to order a Battalion in this manner, the ſecret conſiſts in the obſervation of three things; of which the firſt is,

1. That the Souldiers be ſo ordered as to ſtand with their Arms preſented every way, and to make a Front on every ſide, to the end, that which ſo ever of their Fronts be aſſailed or attacked, they may be able to defend themſelves; as I ſhall ſhew you, by the Example of a Body drawn up in form of a Croſs.

2. To blunt the Angles, that is, ſo to order your Men, that the Angles of the Battalion may be very obtuſe; in ſuch a manner, that the two ſides that form the Angle, joyn together, but with one Right Line onely. For the Angle is the weakeſt part of the Battalion, as being leaſt ſtrengthen'd by the Pikes. For the Souldiers which are next the Angle preſent their Pikes in Front, and not being able therefore to preſent toward the Angle, the Angle muſt of neceſſity lie open to the Enemy. So that the Ancients with whom ſquare Battalions were great in uſe, flank'd their Angels with Little Bodies of Muſqueteers mark'd ABCD; which are ſmall Bodies poſted in the middle of the Fronts of the Battalion, and with which ſometimes they ſecur'd the Angles. True it is, that theſe little Bodies being eaſily cut off by the Cavalry, and beaten off from the Body of the Battalion, the farther uſe of them has been laid aſide.

3. To leave a void Space of Ground in the Center of the Battalion, or middle of the Pikes, ſufficient to receive and ſecure the Muſqueteers, the Colours and the Baggage.

Of

Plate V.

Of a ſquare Battalion of Men drawn up in form of a Croſs.

That this may be done, it is requiſite that the number of men deſigned to compoſe a ſquare Battalion, be ſuch a number as may be divided into four equal parts: Such are 16. 36. 64. 100, *&c.*

Then the Battalion is divided into half Files, and half Ranks, in this manner.

The Word of Command.

1. *Half File of the Right hand half Rank ſtand faſt.* A.

2. *File-Leader of the Right hand half Rank to the Right* C.

Order your Pike.

C Moves to the Right to make a Front toward the Right Wing of the Battalion, and keeps his Ground.

3. *Half File of the left hand half Rank, ſtand faſt,* B.

4. *File-Leader of the left hand half Rank look well to your ſelf* D, *march.*

The half Rank D marches till the half File cloſure of the Angle mark'd 5, be advanced a litte beyond the Souldier mark'd 7, of the right hand half Rank C, as appears in the ſecond Figure.

5. *They that have march'd, Order your Pikes* D.

6. *Half Files ſtand faſt,* AB *to the left, march, ſtand.*

The

The half Files having faced to the left, move toward the left Wing of the Battalion, till the Souldier 6. of the half Files A be advanced, a little beyond the Souldier 4 of the half Rank C.

7. *The half File of the Right hand half Rank to the left* A.

The Half File A faces to the left to make a Front without.

8. *They that have faced to the left, Order your Pikes.*

A Keeps his ground.

9. *Half File of the left hand half Rank, ſtand faſt, To the Right, —March, —Stand.*

The half File B having faced to the Right, marches toward the Head of the Battalion, till the Souldier of the Angle 3, be near the Souldier 9, of the half Rank D, and the Souldier 8 of B, be near the Souldier 2 of A, as appears in the Figure 2.

10. *They that have marched to the left, — Order their Pikes.*

Then B makes a Front towards the left Wing, and the Croſs is formed.

If you would Blunt the Angles, you muſt have other Pikemen, and place them according to the Rule which we ſhall give you in the next page.

Inſtead of blunting the Angles, you may ſometimes plant ſmall Pieces of Artillery, or elſe ſet Wagons or Carts for the ſecurity of the Battalion.

Plate VI.

A General Rule for the blunting or filling up the Angles of the Battalion.

Every little Body that requires the blunting of its Angles, ought to be compos'd of a Square Number

Number of Men, as of 4. 9 16. 25. 36. 49, &c. Therefore you muſt place the Men in Rank according to Arithmetical Progreſſion or Proportion, of which the Interval, Exceſs or Difference of the Terms muſt always be two: Thus, having placed the firſt Man at the Angular Point A of the Figure 1, the ſecond Rank ſhall be of three Men, as being a Number of which the Exceſs, Interval and Difference is Two in reſpect of One. The third Rank ſhall be of five Men, which is a Number that exceeds three by two. The fourth ſhall be of ſeven; the fifth of nine; and ſo forward, ſtill encreaſing every Rank by two Men more than the Rank which is before, according to that ſame Arithmetical Progreſſion, which has always two for the Interval or Difference of the Terms.

Now to place theſe Men in due Order, you muſt imagine that the ſquare little Body ACBD, moves off the Ground T, upon the left of the Battalion Q; and when its laſt Rank AD, is advanced one pace beyond the Wing AD, of the ſame Battalion Q, it turns to the Right, and then the Souldier A of the ſecond Figure comes upon the Ground A of the firſt Figure. The ſides AD, AC, of the ſmall Body meet together upon the ſides that anſwer to one another AD AC of the Angle. Then you command the Men of the little Battalion to make a Front toward the Angle, and when they are drawn up according to this Arithmetical Progreſſion, you cauſe them to make an out ward Front.

Plate VII.

How to frame an Octogon Battalion with Eight Fronts.

Let it be a Battalion of 40 Pikemen drawn up four deep, and ten in Front. You may according to the ſame Method draw up like an Octogon any Number of Pikemen, that ſhall obſerve the ſame Proportion of 4 to 10, between Front and Depth, as 8 in Depth, and twenty in Front, 16 in depth and 40 in front, or 32 in depth and 80 in front. For in this Example I have choſen this little Number of Pikemen, to give the more light to the ordering and diſpoſing of a far greater Number.

The Words of Command.

1. *The two Right hand Files, and the two left hand Files ſtand faſt, AB IL.*

2. *The half File of the two Right hand Files face to the Right, B.*

3. *The half File of the two left hand Files, face to the left L.*

4. *Files of the Wings, march.*

The half File B moves into the Ground 4. L. moves into 5. A moves into 7. and J into 8. which four Bodies are deſigned to blunt the Angles.

There remains afterwards upon the Ground of the Battalion the ſix Files CD GH. which muſt be opened by half Ranks, and half Files to form the Croſs of the third Figure, and to clear the Ground of the Center, by a Quarter Wheeling.

5. *The half File of the Right hand half Rank C, half turn to the Right, Order your Pikes.*

C Makes a Front towards the Reer, and keeps his Ground.

6. *File-*

6. *File-leader of the Right hand half Rank to the Right G, march, ſtand.*

The three Files G make a Front toward A upon the Right Wing, and advance on that ſide two or three Paces beyond their Ground; and ſo that which was a File is become a Rank.

7. *They that marched ſtand faſt, G to the Right a Quarter Wheeling.*

The three Files G, make a Quarter turn to the Right, and wheel about the Souldier R, in like manner as the Right Wing TY of the firſt, and become placed as you ſee the 2 Figure; where the three Files G are marked with the ſame Letters as they are in the Body of the firſt Figure.

And becauſe that after the wheeling they make a front toward VR, to the end they may make a Front outward on the ſide of VXY, [the next Word of Command is;]

8. *To the left,* ———*Order your Pikes.*

9. *File-leader of the left hand half Rank, ſtand upon your guard, H march.*

Take notice in the 2 Figure of the three Files H, marked with little Points. Theſe you cauſe to march forward along the Line marked PM QF, to gain the Ground H marked with three great Dots in the ſame Figure. But to gain this Ground, they march beyond the Ground of the Battalion, till the ſecond Rank pointed PN have advanced three Paces farther than the Flank YT of the three Files G, which then make a wheeling; which will happen when the Souldier P, ſhall be upon the Ground Q, and that the Souldier M ſhall come upon the Ground F, at what time the Word of Command.

10. *To the Right,* —*March.*

To

To make a Front toward the three Files G, and when they ſhall come to be three paces from the Reer of the three Files G, then command 'em.

11. *To the left, Reſt your Pikes.*

Then they will make a Front outward, and ſo ſhall keep their Ground.

12. *The half File of the left hand half Rank, ſtand faſt, D March, —ſtand.*

The half File D, advances two Paces beyond its Ground.

13. *To the Right, —a Quarter Wheeling.*

The half File D makes a Quarter Wheel about the Souldier Z, as you may ſee in the third Figure, and becauſe that after the wheeling, they make a Front inward toward the Center, therefore to change the Front outward, the Word of Command is:

14. *They that made the Quarter Wheeling, wheel by half Converſion to the Right.*

The Croſs being thus made, you bring the four Files upon the Ground, 4, 5. 7, 8. and blunt the Angles according to the foregoing General Rule.

Plate VIII.

The manner of drawing up a Battalion in a Hexagonal Figure, with a void ſpace in the Center, and the Front of the Battalion five Times exceeding the Depth.

We ſuppoſe the Battalion to conſiſt of 720 Pikemen, twelve deep and 60 in front, which is to be drawn up into an Octogonal Figure like that marked thus 8.

The Battalion being drawn up in the large black draught of the firſt Figure, to bring it to the Square marked with Points in the ſame Figure,

gure, the following Words of Command are to be made uſe of.

1. *The twelve Files of the Right Wing, of the twelve Files of the left Wing, ſtand faſt,* CDQ, PAB.

2. *The ſix Right hand Files of the Right Wing, and the ſix left hand Files of the left Wing,* CD, AB.

3. *They that have advanced double their Files inward to the Front and Reer.*

A Takes the Ground V, B takes the Ground T, C takes the Ground O and D poſſeſſes R.

4. *They that have had the Word of Command, and they that have doubled, ſtand faſt* VPT, OQR.

5. *Middle Files ſtand faſt,* ME.

6. *Advance your Pikes, Middle Files* EM.

7. *The half File of thoſe that advanced their Pikes, wheel by half Converſion to the Right.*

8. *March thoſe that advanced their Pikes, till the firſt Rank be advanced one Pace farther than the firſt of the Files that doubled Front and Reer.*

M and E Move and change into the Ground marked with the Points M and E, and form the Square repreſented by the ſame Points, which is afterwards to be conſidered in the Figure K.

9. The ſix Right hand Files, and the ſix left hand Files that marched wheel by half Converſion in IFHH, which done, they make a Center toward the Center of the Battalion.

10. *They that have wheeled by half Converſion to the Right, march toward the Center till the laſt Rank be all entered.*

I and F come upon the Ground Y, and HH, upon the Ground GG where as they ſtand, they are cauſed to turn to the right and left, to advance forward, that is, Y fronting Y, and G fronting G, by which means YYGG, poſſeſs the Ground NNNN.

The

The Ground IY and FY becomes void.

Then the word of command is to be given to the two particular Battalions, OQRUPT, which in regard they make a front inward, you muſt order the Battalion OQR, to make a half wheel to the right, and the Battalion UPT, to make a half wheeling to the left, and by that means they will make a front inward, and you ſhall cauſe them to march to the Center, and the O and V ſhall poſſeſs the ground Y, Y and R and T ſhall poſſeſs the ground GG.

Then you muſt cut off Eight fourths of the Ranks ORUTLLLL, and reduce them into Triangles to blunt the four Angles that are next them, and the Battalion ſhall be formed after an Octogonal figure, as in the figure marked ♂, where you ſee the ſame letters made uſe of here, they anſwer to the ſame letters in the two other Figures.

You have 532 Muſqueteers at 12 in depth, and 44 in front, there will remain 4. The 532 Muſqueteers, ſhall ſerve for the Flanks of the Battalion of Pikes, and to that purpoſe you ſhall take 12 Files of their right Wing, which will make 144 Muſqueteers, and as they will be equal in front to the Body of the Pikes marked E, you ſhall march them to the head of the ſaid Body, and cauſe them to enter into the Center through the Intervals of the Pikes.

When they are advanced toward the Center, divide the Ranks in half, ſo that one half Rank ſhall march toward the Body of Pikes marked Q, and the other half Rank towards the Body of Pikes marked P.

After this take from the left Wing of the Muſqueteers twelve files more, which make 144 men; and cauſe them to advance toward the Center

through the Intervals of the Pikes E, and then divide them by half files.

One half File ſhall advance toward M, and the other half File ſhall ſtand their ground behind the Pikes E.

For the 304 Muſqueteers that remain, they ſhall make the two Files that ſurround the whole Body.

Plate IX.

How to reduce a Battalion with a void ſpace in the Center.

You begin with the Muſqueteers which you command from the Center through the ſeveral fronts MPEQ, which together with thoſe that ſurrounded the Body, you cauſe to rank and file themſelves as they were.

As for the Pikes that form the Octogonal Body, you give them the following Words of Command.

1. *They that ſtand in the Angles to your Places* O *and* R, *reſume their diſtances, and make the ſame front as* Q. *The Files* V *and* T *do the ſame in reſpect of* P, *and the Files* LL *obſerve the ſame order; in regard of the Pikes* ME.

2. *The* 12 *files of the right Wing, and the* 12 *files of the left Wing, that doubled Front and Reer, ſtand faſt* OQR, UPT.

3. *March Files of the Wings that have received the word of command* OQR *and* UPT, *move off and march forward.*

4. *They that doubled Front and Reer, to your Places* O *and* R, *return to the Ground which is marked in the firſt Figure, by the Letters* CD *and* UT, *return to the Ground* A *and* B *of the firſt Figure.*

5. *The*

5. *The Files that marched toward the Center, to your Places, the four ſmall Squares NNNN, return to the Front of M and E.*

6. *The middle Files ſtand upon your guard, EM.*

7. *The half File of the middle Files half a Turn to the right M makes a front toward the ſame Center.*

8. *File-Leader of the middle Files, half a Turn to the Right, E makes a front toward the ſame Center.*

9. *March middle Files —— E and M move forward till they come upon the Front CDQ. and PAB of the firſt Figure.*

10. *File-leader of thoſe that marched, half a Turn to the Right, E returns to its firſt Front, and the Battalion is reduced.*

Plate X.

Of an Army in General.

Squadrons of Horſe are commonly compoſed of 80, 100 or 120 Troopers, and ſeldom exceed 200.

Battalions are made as ſtrong as may be, the Pikemen always in the middle, and the Muſqueteers on the Wings.

An Army is commonly divided into 3 Bodies which are ranked in 3 lines, the firſt line is called the Vanguard A, the ſecond the main Body B, the 3d. the Reer-guard C, or Body of Reſerve. The middle of theſe 3 lines conſiſt of foot as D, and the Cavalry is on the Wings as at E. Sometimes the Squadrons are placed in the Intervals betwixt the Battalions, that ſo, when the foot hath fired and began to put the Enemy out of order, the Horſe may more eaſily break in, and charge through thoſe Intervals, and ſo make an intire

rout, and alſo in caſe it ſhould happen, that the infantry ſhould have the worſt, having fired and charged; then the Cavalry is immediately at hand to ſuccour, and give them time to rally again.

If we conſider the number of foot which compoſe a Battalion, which conſiſt of about 1000 men; and the number of Horſe-men that make up a Squadron, which at moſt is not 200; it is that though there be but very few Cavalry in an Army, yet the Number of Squadrons is double, yea triple the Number of Battalions: So that for every Battalion, in the middle of each of the 3 lines, there will be 2 or 3 Squadrons in the Wings of the ſame line.

When an Army is drawn up in Battalia, there is 5 foot ſpace allowed between each Horſe-man, and 3 foot between each Footman, that is, for the front or diſtance of one file from another; But when the Battel begins, the files cloſe, and the front is leſſen'd about one half.

There is alſo left about 100 paces between the firſt line and the ſecond, and 200 between the ſecond and the third, that ſo the Troops if broken may have ground enough to rally on, which otherwiſe would not be ſufficient.

In every line the Battalions are diſtant from Battalion, and the Squadrons from Squadron, almoſt equal to their Front; ſo that the Front of a Squadron extending about 2 or 300 foot, the Intervals between two Squadrons ſhall be 2 or 300 foot more or leſs, and the Front of a Battalion, being between 170 or 180 foot, the interval between the two Battalions, ſhall be within a little equal to their front.

Theſe intervals are left thus large becauſe the Squadrons and Battalions of the ſecond line, are placed

placed juſt behind the Intervals of the firſt. And likewiſe the Bodies of the Reer-guard are placed juſt behind the Intervals, that are between the bodies of the main Battel, that ſo by theſe Intervals, both may more eaſily advance againſt the Enemy; and if the firſt line be broken inſtead of falling back upon the Troops of the ſecond; (which muſt needs happen if the Bodies of all the lines made but files) it might rally behind its own ground, and leave the interval free for the ſecond line to advance, and maintain the other that gave ground.

Plate XI.

Of the March of an Army in a Flat and Plain Countrey.

The General having given out orders the Night before he deſigns to march the Army, let every one be ready to march the next Morning by break of day. The Horſe and Foot ſhall repair betimes in the Morning, under their ſeveral Colours and Enſigns, to the place where every Company is to be drawn up.

All the Companies being drawn up, they ſhall begin to march, and muſt range themſelves in Squadrons and Battalions, to be afterwards embattel'd in the Ground marked out by the Marſhall of the Camp, or his Aſſiſtants.

The Marſhal of the Camp ought in the firſt place, to be exactly enformed of the Condition of the Countrey; through which the Army is to march, taking his inſtructions from the General and particular Maps of the Countrey, or from the information of the Countrey People.

He ſhall draw up his men in Battel array according as he thinks moſt convenient, or as the General ſhall have given him Order. If it be through a plain and open Countrey, which is convenient for the Horſe Cavalry, the Artillery and Wagons, then let him extend the Wings of his Army, and obſerve the following Order.

He ſhall divide his Army into three Bodies.

That in the middle muſt conſiſt of three thirds of the whole Infantry, drawn up in great Bodies and Battalions, each conſiſting of two or three Regiments.

Upon the Wings or Flank of this Infantry, muſt be placed the great Artillery, guarded by ſome Battalion of the Infantry.

Upon the right and left Wing of this middle line ſhall the Cavalry march, in little Squadrons each conſiſting of two Cornets. The reſt of the Infantry marching in little Bodies, ſhall encloſe between it and the Cavalry, the Baggage and Ammunition of the Army, with ſome field Pieces; as may be obſerved by the March repreſented in the Figure aforeſaid.

Plate XII.

Of the March of an Army through a Countrey difficult to paſs by reaſon of narrow and rugged Ways.

In leading an Army from one place to another, there is no accident that can be met with, more troubleſome to its march, than when it is conſtrain'd to paſs through narrow Paſſages and long Lanes.

If theſe ways lye over Mountains, the Generals muſt ſend his Forlorns to poſt themſelves upon the higheſt places, that look into the Bottoms round

round about, to diſcover whether the Enemy be there entrenched, and to obſerve the Situation of the Plains, ſtriving all along to gain Intelligence of the March of the Enemy.

If the Roade be covered with Trees, care muſt be taken to ſend a day or two before the Army arrives, Carpenters, and Pioneers with a good guard of Horſe to defend them while they cut down the Trees, and enlarge the ways, to the end the Army may march in a Body. Firſt you ſhall ſend before a Squadron of Horſe; and after them a Body of Horſe, that muſt be well backt by a Body of Infantry, then ſhall follow the Train guarded by ſome Battalion of Foot; then ſhall the reſt of the Army follow, ſecured by a good Body of Horſe that brings up the Reer. But if the Countrey be ſo rugged, as not to admit of any paſſage for Carriages and Artillery, of which notwithſtanding there is a neceſſity; or ſuppoſing the Rode lye over Mountains, Hills, Valleys, Rivers and ſuch like difficult places, then muſt the General cauſe new Canon to be caſt upon the way in convenient places, turning a little out of the Rode. In the mean time his Scouts muſt be always abroad to gain intelligence of the Enemy, and when he is perfectly informed how the way lyes, and that he has made a paſſage for his great Guns, he muſt divide his Army into two Bodies; of which he ſhall cauſe the one to march file by file; after them ſhall follow the Artillery, and the ſecond Body or Reer-guard.

Plate XIII.

Of the March of an Army through an Enemies Countrey.

If there be a neceſſity to carry the War into the Enemies Countrey, either to beſiege ſome place therein; or elſe for the Relief of ſome place already beſieged, whether the Enemy be beaten in the Field, or whether he ſtill keep the Field to put new ſupplies of men and proviſion into the Garriſon, or hinder proviſion from being brought to the Enemies Camp.

Upon all theſe occaſions whether he encamp in the Field, or quarter in Villages, the General muſt take care that the Commiſſary General of the Victuals, and the Treaſurers at War be diligent and Faithfull in their Charge in providing, and furniſhing the Army with Victuals.

If the Enemy has been routed and be not in a condition to recruit, then you may march as in the preceding pages, whether the Countrey be open, or ſtreighter.

But if after a rout the Enemy be rallyed again, ſo that they are able to make head againſt the Victor, then it behoves the General to march cloſe; and to the end the Army may be in a condition to open their paſſages and make their own way, it muſt be divided into little Bodies.

The Cavalry muſt be placed upon the Wings, in front and in the Reer of the Bodies. The Infantry muſt march in the middle, and in a groſs Battalion. The Artillery upon one ſide guarded by ſome old Regiments, as you ſee in the Plate.

Of

Plate XIV.

Of the March of an Army in a close and cover'd Countrey.

An Army never ſuffers greater inconvenience, than when it is forced to march through a Countrey abounding with Woods and Rivers, eſpecially if it be in the Enemies Territories. For beſides that it is impoſſible to march in order, the ways and paſſages in theſe ſort of Countries are for the moſt part ſtrangely incumber'd with Woods and Rivers.

Now an Army being conſtrained to paſs through ſuch Countries, it behoves the General to ſend his Engeneers with a Party of Horſe, and ſome Companies of Foot, and Pioneers; to fill out the Ditches, raiſe Bridges and build Boats, and in a word, to do what ever the Engeneer ſhall command and ſee fitting; to facilitate the march of the Enemy. In the mean time the General muſt be carefull to ſcoure the Country with his Cavalry, to the end he may get intelligence of the Enemy, whether he be in the field, and which way he marches, for the better avoiding Ambuſcado's and Surprizes. And then it is that a General ought to have his ſpies moſt active and buſie to diſcover the deſigns of the Enemy, which is the greateſt Advantage a General can wiſh for at ſuch a Conjuncture.

The General muſt inform himſelf by his Scouts of the condition of the Enemy, which he muſt not believe but upon the confirmation of many; and knowing that he lies expecting him at ſuch a paſs, he ſhall advance with his Army in the beſt Order the Countrey will permit.

But

But if he underſtands that the Enemy waits to ſurprize him, at ſuch or ſuch a narrow paſs; or croſſing a River, where he muſt file off his men, or that the Countrey people, are entrench'd with ſome Companies of Foot in any Village or Caſtle, then he muſt call a Counſel of War to conſider what is to be done.

Plate XV.

The manner of encamping an Army conſiſting of Horſe and Foot.

The neweſt manner of encamping an Army, is to diſpoſe it into two lines, with a reſerve. But then we muſt ſuppoſe the Ground to be convenient.

Care is then to be taken that between the one and the other line, there be the diſtance of Three hundred paces, at 3 Foot to a pace.

That all the Squadrons of Cavalry of each line have allowed for every one five and thirty Paces of Ground, and that there be as much void ſpace between the one and the other, to the end that one Squadron may paſs through the intervals, if there be an occaſion to engage.

The Battalions of infantry which are ſtrong, and encamped in Battalia ſix men deep, muſt have fourſcore paces of ground allowed them, more or leſs, according to the ſituation of the Place.

Between the Squadrons of Horſe and the Battalions of Foot, of the ſame line muſt be left the diſtance of forty or fifty paces. As for the Artillery, the great Guns muſt be planted upon the firſt line of the infantry, in ſuch places as ſhall be thought of moſt advantage.

The Baggage and Ammunition, muſt be ſecur'd between the ſecond line and the body of the reſerve upon the right hand, and the proviſions upon the left: or next to the Tent of the Commiſſary General of the Proviſions.

The Quarter-Maſter and Sargeants as well of Horſe as Foot, are to pitch their Tents at the Head of their Squadrons and Battalions, the other Officers Tents behind. The Parading place, and the Principal Corps Du Gard, are to be always at the head of the Camp, where the Arms, Colours and Enſigns are lodged.

The Horſe are to be poſted on the Wings, and the foot on the middle.

To every Squadron conſiſting of 3 Troops, and 50 men in each Troop, ſome allow 50 paces. And to every Battalion conſiſting in 16 Companies, and 50 men in each Company, 100 paces for their encamping.

The Dragoons are never to be encamped in the Body of the Army, but have their Camp at the Head or on the Wings on that ſide, where the greateſt danger is, ſerving always as an outguard for the Army.

Every Regiment ought to have a guard at the Head of their Camp, and the Major General for that day takes care to place the great Guard in a proper place and diſtance from off the Army, towards the Enemy: Chooſing for that purpoſe a place where all the Avenues may be diſcovered.

Plate XVI.

Of encamping a Battalion of Foot.

The ground allotted or commonly aſſigned for encamping a Battalion is 100 paces, which by the Quarter-Maſter is divided thus, *Viz.* For each Hut 7 Foot ſquare, 2 Foot to the By-ſtreets, and 15 Foot to the great ſtreets, and 2 Foot diſtance between the Huts, and every Company containing 50 men ought to have 10 Huts.

The Kitching muſt be marked out at 12 Foot diſtance from the laſt Row of Huts, and are to be placed juſt over againſt them, ſo that the ſtreets may be open quite through for the Officers to paſs eaſily to the Head of the Camp, as there ſhall be occaſion. The length of the Kitching is to be about 9 Foot, and the Breadth 6 Foot.

There is about 30 paces diſtance between the Soldiers Kitching and the Captains Tents; and 40 paces diſtance between the Captains Tent and the Front of the Subaltern Officers; and the remaining Ground is for the encamping of the Field Officers, and the Captains Equipage; the Sarjeants Huts are to be at the Head of the Soldiers to open the contrary way, that is, to the Front.

The Sutlers are to be encamped behind the Officers Tents, there muſt be 25 or 30 paces between one Battalion and another; and the Colonels, and Field Officers, and Staff Officers Tents are to be in the Center of the Battalion behind the Tents of the Captains.

The Pikes are to ſtand at 18 Foot diſtance from the Huts, the Muſquets at 18 Foot diſtance from the Pikes, the Colours and Drums are to be ſet within the Hollow of the Pikes.

To

Plate XVII.

To encamp the Cavalry.

To encamp a Troop of Horſe of 100 Men, there is aſſigned them for the whole Troop 70 Foot in Front, *viz.* AB, and 200 in depth, *viz.* AC.

To two Horſemen is allotted 8 Foot in breadth and 12 in length, to make their Huts or Baraques as at D.

And for the Huts or Baraques for their Horſes, there is allowed to each 4 Foot in breadth and 10 in length, as EE, the Men and Horſes are both lodged in two Ranks as EG, the Horſes heads ſtand towards the Huts of their Maſters.

Between the Huts and Stables there is a Lane or Space 8 Foot broad, the Captains Lodgings or Tents are at the Head of the Baraques of his Troop, the whole Front of which he poſſeſſes; and the breadth of it is about 40 Foot, as at O.

Between the Lodgings of the Captain and the Troop there is a Lane or Space of 20 Foot broad, as at P.

The Lane betwixt the Stables is 10 Foot broad, *viz.* L, that ſo the Horſes may have room to come forth.

Behind the Troops are poſted the Sutlers, divided from the Troop by a Lane 20 Foot broad, *viz.* R. If many Troops encamp together the Space between them is commonly 20 Foot.

We in *England* allow 3 paces for the length of a Baraque, and 2 paces diſtance the opening of the Baraques to the Stakes to which the Horſes are faſtned, and 3 paces for each Horſes ſtanding, and 10 paces for the Street, and the Ground allotted for a Squadron of

of 150 men is commonly 50 paces, and commonly 10 or 12 Baraques on a Row for every Troop of 50 Men, and about 2 paces distance from one Baraque to another, and 15 paces for the distance of one Squadron to another.

Plate XVIII.

General Directions for encamping an Army.

When the Camp-Master General, or Major General hath read the Number of the Horse and Foot, that are in the Army, he must proportion end cast up what Space of Ground will suffice to encamp them with all their Provision, Carriages, and so that neither for due Room the Soldiers be pestered, nor by over large Spaces the Camp not sufficiently fortified.

This being of great importance, it will be requisite for him to understand well Arithmetick and Geometry, and to have in readiness sundry Plats and Models, and Forms of Camps, whereby he may suddenly resolve for any Number or Situation, what Form and Quantity is most convenient, and presently stake it out; assigning due place for every Regiment of Horse and Foot.

Before encamping he ought to consider if the Army consist much of Horse, that there be good store of Forrage nigh the Camp, and that the Camp be not subject to any Hill from whence the Enemy may with his great Artillery incommode it: Nor that it be so separated from water, that the Enemy may easily cut you from it; nor that it be so low as that the Enemy by cutting the Banks of any River, may drown the Camp. And if there be no great Rivers but onely Fountains or Wells of Water, then must good watch be kept

that

that they be not poyſoned nor infected by the Enemy. In a running or moveable Camp the readieſt Fortification is to impale it round with the Carriages chained together, bending the Artillery that way where moſt ſuſpicion is, the Enemy will approach, and if time permit to caſt ſome Trench alſo without the Carriages, as in Plate XVI, where A is the General's Tent, B the Guards of the General, C the Park of the Artillery with its Retrenchments, D the Waggons for the Ammunition, E the Waggons for Proviſions, F the Soldiers Huts, G the Gourt of Guard, H the Retrenchments, I the place for drawing up the Army into Battalia.

Plate XIX.

The manner of ranging a Battel in order to a preſent Engagement.

A General is ſometimes conſtrained to a Battel, when he is in an Enemies Countrey upon the falſe report of his Spies ; eſpecially of ſuch as play faſt and looſe receiving pay from both ſides, which are a ſort of People very dangerous. Sometimes through the ignorance of thoſe that command the Parties who ſeeking to get intelligence of the Enemy, never inform themſelves thoroughly of their March.

Sometimes he engages himſelf voluntarily, deſigning to relieve ſome place that is beſieged. But which way ſoever it be, that he is forced to come to a Battel, he muſt endeavour to order his men after the following manner.

He ſhall range his Infantry in Battalions, every one conſiſting of five or ſix hundred men, or a thouſand men, which are the moſt convenient num-

numbers, with the Numbers between to form a juſt Body. For thoſe Bodies that exceed the Number of a thouſand, can never be drawn up conveniently upon all ſorts of Ground; and ſuch as are under 500 will never be ſtrong enough to reſiſt at the ſame time the fury of the Enemies Horſe.

His Cavalry which ſhould be always drawn up upon the Wings of the Infantry, muſt be drawn up in Squadrons, conſiſting of a hundred or thereabouts. But the beſt, and thoſe that are moſt ſerviceable to break the Battalions of the Enemy, are thoſe that conſiſt of 150 or 200 at moſt; for if they exceed the Number of 200 they are not eaſily nor conveniently drawn up, by reaſon of the length of their Ranks, and the Number of Horſes. And thus it was that the Count *de Schomberg* embatled his forces at the Battel of *Monteſclar*, which he wone from the Marqueſs of *Caracene*.

An Army which is embattelled in ſmall diviſions of Horſe and Foot, is not ſo eaſily routed as that Army which is embattelled in great diviſions. And ſmall diviſions are much more ready than great: For beſides ſeconding one another, and wheeling upon all occaſion, they will likewiſe outfront an Army which is embattelled in great diviſions: The which is one of the greateſt advantages that can be taken in the embattelling of an Army. Small Diviſions of Horſe and Foot are alſo much readier for ſervice, where you cannot embattel them according to the Rules of Art by the nature of the place, or with incloſures, or where the brevity of time will not give you leave, beſides ſmall Diviſions are much more troubleſome for an Enemy to deal withall than, an Army that is embattelled in great Diviſions. *Ge-*

Plate XX.

General Directions for giving of Battel.

When a General intends to give Battel, he muſt have regard to theſe principal things: *Viz.* He muſt never ſuffer himſelf to be forced to fight againſt his will, and never to fight his Soldiers when their Spirits are diſmayed and caſt down; care muſt be taken to chooſe a place for the Battel fit for the Quality and Number of your Soldiers. If you fear to be encloſed by a great Number, you ought to ſhelter your Flanks, or at leaſt one of them, by the nature of the place, as by a River, Wood, or the like. If weak in Cavalry you muſt avoid the Plains, or fight with Foot among your Horſe. If you be ſtrong in Horſe, you muſt avoid ſtrong paſſages, or encloſed places.

Directions are the life of Action, and the ſinews and ſtrength of Martial Diſcipline, and therefore Orders ought to be written before the Battel begin, that every Officer may know his duty, and be left without excuſe.

For placing your Diviſions of Horſe and Foot at their true diſtances, you ought to allow unto every Horſe-man in the Front of the Diviſions of the Vanguard and Battel, 6 Foot of Ground in breadth, and to every Foot-Soldier 5 Foot.

Alſo between every two Diviſions of Horſe and Foot, in the Vanguard of your Army to allow 100 paces of Ground in breadth of 3 Feet to the pace, beſides what you allow for the Diviſion of the Battel which is for the Reſerve.

There ought alſo to be allowed between the Vanguard of the Horſe Troops, 150 paces of 3 Feet to the pace; this Order muſt be obſerved both in

placing the Diviſions of Horſe and Foot, and the Vanguard Battel and Reer-guard of your Army, that the formoſt Troops being put to recoil, may not fall upon thoſe which ſhould come up to relieve them, nor the Battel upon the Reer.

The beſt Regiments of Horſe and Foot, ought to be placed on the Wings of the Army.

The Officers that lead the Diviſions in the Vanguard of a Battel, ought to have ſpecial care to ſee, that the Diviſions both of Horſe and Foot keep their diſtances. But eſpecially the Officers that lead the Diviſions in the Vanguard of your Army, on the Flank of your Horſe or Foot, they muſt be extraordinary carefull, that they cloſe not with their Diviſions in upon the main Body. And there is no one thing that the Officers care is required about in fighting a Battel, more than to ſee that ſuch Diviſions as they command keep their diſtances; otherwiſe it is impoſſible but ſome part of your Army, if not the whole, will be in a confuſion before the Battel be half fought.

If it happens, as it moſt commonly doth, that when two Armies are embattelled one againſt the other, that the one Army out-fronteth the other, upon one of the Wings, and the other Army out-fronteth the other upon the contrary Wing, when both Armies come to encounter. Therefore let there be punctual Orders given to the Commanders, on the outmoſt Flanks of the Vanguards of the Horſe, that if either Wings of Horſe do out-front his Enemies Wing of Horſe, that they advance eaſily, keeping their Order with that Wing of Horſe, which they command as ſoon as their Cannon begin to play, and not before, and charge that Wing of Horſe which they do out-front.

Command

Command alſo thoſe Diviſions of Horſe, that out flank your Enemies; that when they come within a near diſtance of your Enemies Troops, ſo to wheel with their Diviſions, that they may be able to charge that Wing of their Enemies Horſe on the Flank, at the ſame time when the reſt of the Horſe chargeth them in the Front: And if you out-front your Enemies Army on both Flanks, then both your Wings of Horſe muſt obſerve the ſame Order.

But if you be out-flanked in one of your Wings of Horſe, then the General ought to give Order to the Officers of that Wing, not to advance from the main Body of the Foot, but keep an even Front with the Foot untill the Enemies Horſe come up cloſe to them to charge them; or to order the Officers to draw up on the outermoſt Flank of that Wing of Horſe that is out-flanked, the Reer-guard of Horſe of the ſame Wing of Horſe, with all the expedition that may be: or if any of your Diviſion of Horſe do front againſt the Enemies Foot, when you are out-flanked by the Enemies Horſe, that then the Officers draw off thoſe Diviſions of Horſe upon the outermoſt Flanks of the ſame Wing of Horſe, which is out-flanked.

The principal Heads of War for Field-ſervice, are the Art of Marching, Incamping, Imbattelling, skilfully to get good Intelligence, providently to get good Proviſions for the Army.

In Matters of War the motions ought to be quick where the leſt motion of time oft marreth the whole buſineſs.

It is neceſſary in War oftentimes to change Counſels according to the variety of Accidents.

In Execution of Deſigns of War, good Judgement ought to ground them, and diligent expedition put them into Action.

The Office of a chief Commander is, a Subject capable of the greateſt Wiſedom that may be apprehended by natural means; being to manage a Multitude of diſagreeing minds, as a fit Inſtrument to execute a deſign of much conſequence, and great expectation, and to qualifie both their apprehenſions and affections, according to the accidents which riſe in the courſe of his directions, beſides the true Judgment which he ought to have of ſuch circumſtances which are moſt important to a fortunate end; wherein our providence cannot have enough, either for learning or experience, to prevent diſadvantages, or to take hold of opportunities.

It is not onely experience and practice which maketh a Soldier worthy of his Name; but the knowledge of the manifold Accidents which ariſe from the variety of humane Actions, which is beſt, and the moſt ſpeedily learned by reading Hiſtory: For upon the variety of chances that are there ſet forth, he may meditate on the effects of other mens adventures, that their harms may be his warnings, and their happy proceedings his fortunate directions in the Art Military.

It is requiſite alſo that a Commander be well acquainted with the divers and various ways of imbattelling, and well to underſtand the nature and reaſon of them, that ſo he may with knowledge apply them to the quality of any occaſion.

I might have added the way and manner how to attack and defend any fortified Town, as alſo Military Stratagems, and Policies practiſed by valiant

valiant and prudent Commanders, whereby they have obtained miraculous Victories or eſcaped imminent dangers. But there is no ſcience, or faculty whatſoever in multitude of parts, that may any way be comparable to the Art Military; wherein every ſmall and unexpected Circumſtance quite altereth the Nature and Deſign of the Action: And among the variable events of War, many unexpected occaſions ariſe which gives preſent Advantage and Victory to him that is ready to take it, and many ſtrange Chances ſo alter the Courſe of things, that no direction can prevent, nor foreſight diſcern what may happen. So that one fault committed in War can never be repaired, and one hour cauſeth the loſs of that reputation which hath been many years acquiring.

I will therefore onely give this advice to all Governours that are to defend a beſieged Town, that they have a ſpecial care of theſe three things. The firſt is, that from the beginning to the end of a Siege their law be ſuch, that their Garriſons ſpend no more Victuals daily than Neceſſity requireth: The ſecond things is, that they do not vainly waſt their Men or Ammunition, but ſo order the expence, that it may hold out with their Victuals; for often times prodigal expences and needleſs waſtings have brought many Garriſons to want Neceſſaries for the defence of the Town, more than the preſſing ſervices and efforts of the Enemy: The third thing is, that they carefully defend the Outworks, eſpecially the Mote and Body of the Town, with all the Care, Judgment and Valour that their Garriſon affords, to loſe all things inch by inch, and to quit nothing but by main force.

In the Courſe of War, a General or Commander ſhall meet with ſome occaſions, wherein he is not onely to contend with men; but with Chances and Things which are to be overcome with no leſs difficulty than an Enemy, and are more dangerous, as Hunger, Diſcontent and Labour, *&c.* But Induſtry commands Fortune; and Diligence by circumſpect and carefull carriage, ſeldomf ail; 'tis neceſſary to joyn Judgment with Valour in all Martial Actions, for 'tis not the length of Life or Number of years that teacheth the Art of VVar, but continual practice and experience.

I conclude with a ſaying of one of our Great Engliſh Generals, the Duke of *Albermarl*, whoſe ſaying it was; That a rich publick Treaſury prudently managed, and a People well trained in martial Affairs, were the two onely Pillars next under God, that would preſerve a Kingdom or State from Danger and Ruine.

F I N I S.

ADVERTISEMENTS.

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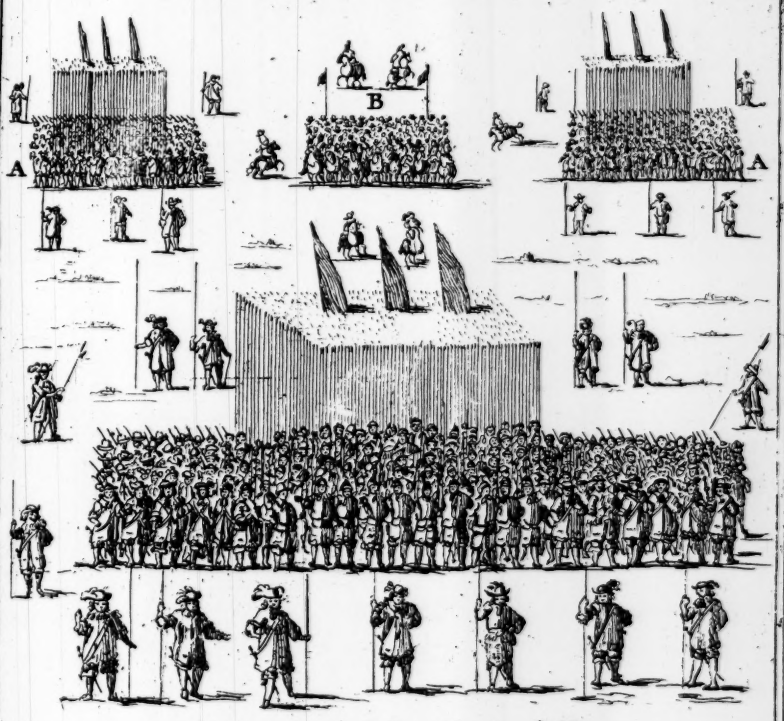
Plate. I. S. P.



H P V Z L I Y S N G

F E

D C

B Q T & M K X R O A

A A

Facing p.g. Plate. II A S. P. Facing p.g.

Fig. 1.

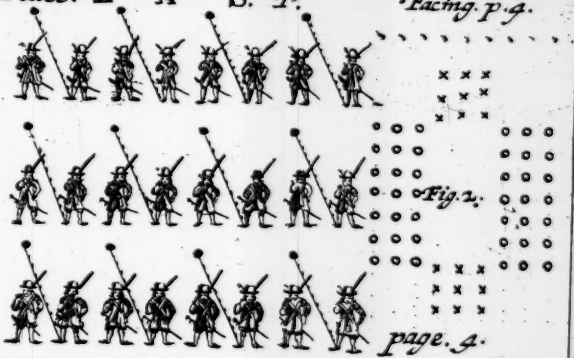
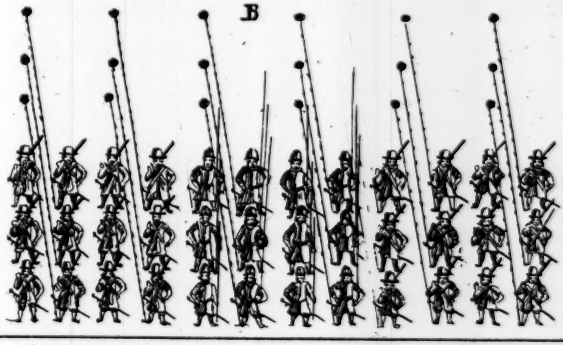


Fig. 2.

See page. g.

B



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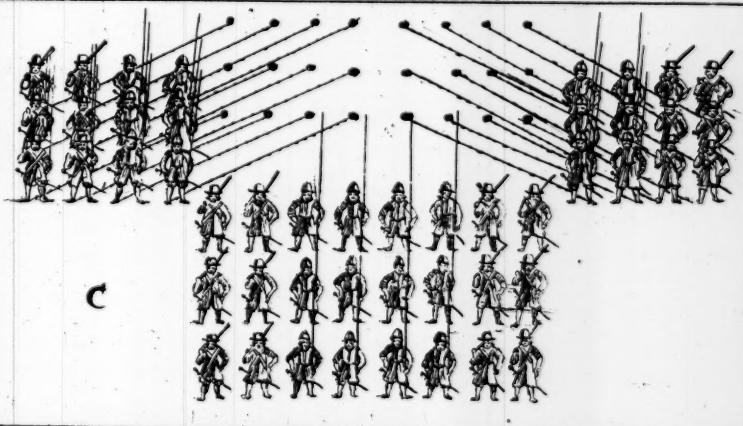
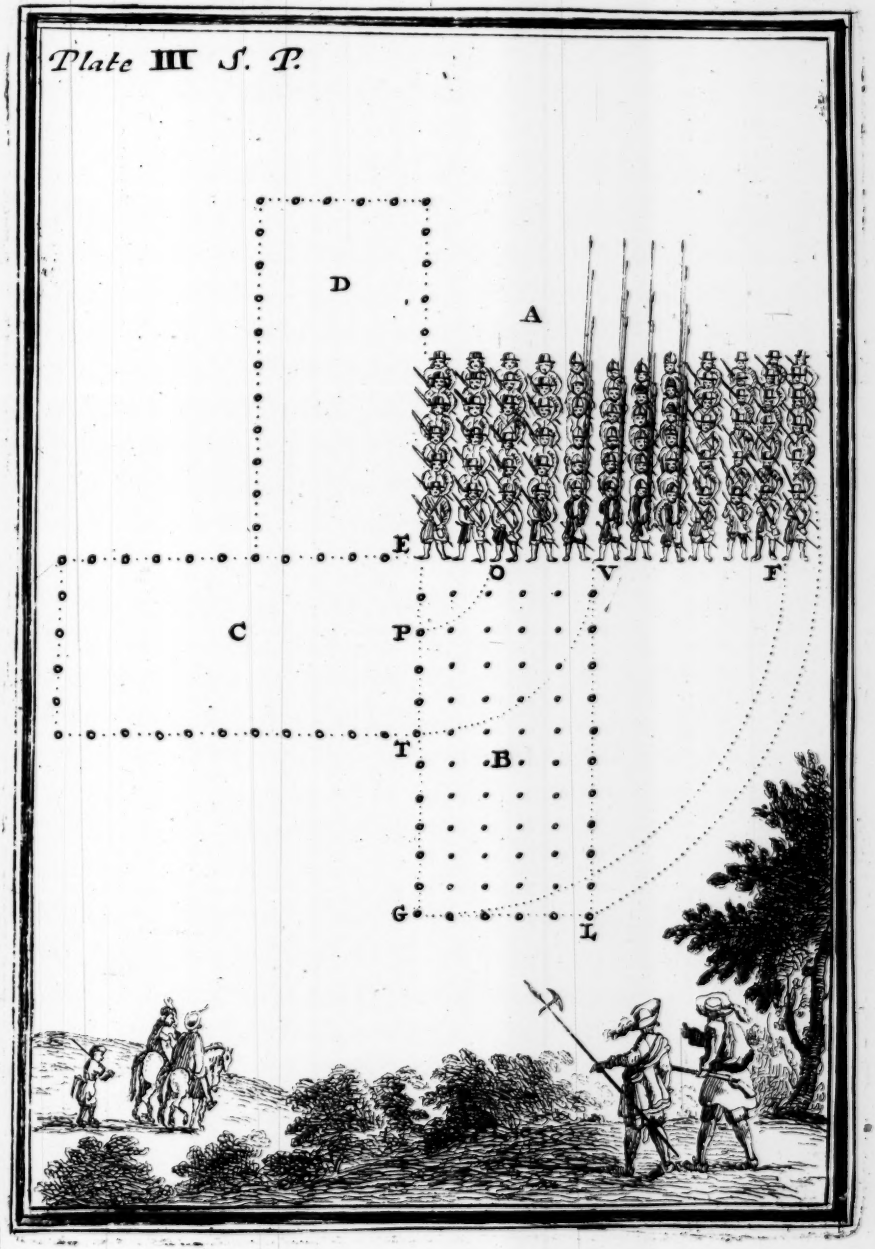


Plate III *S. P.*



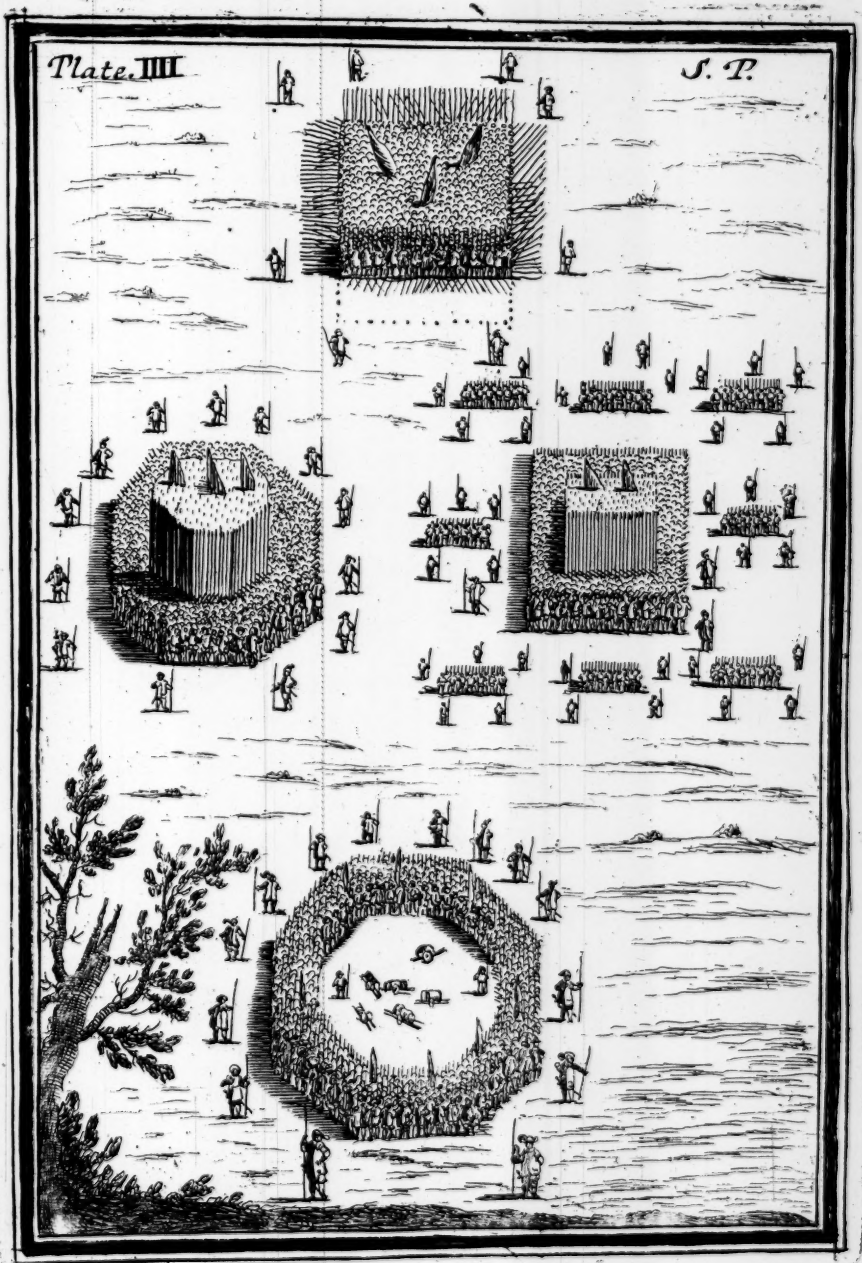
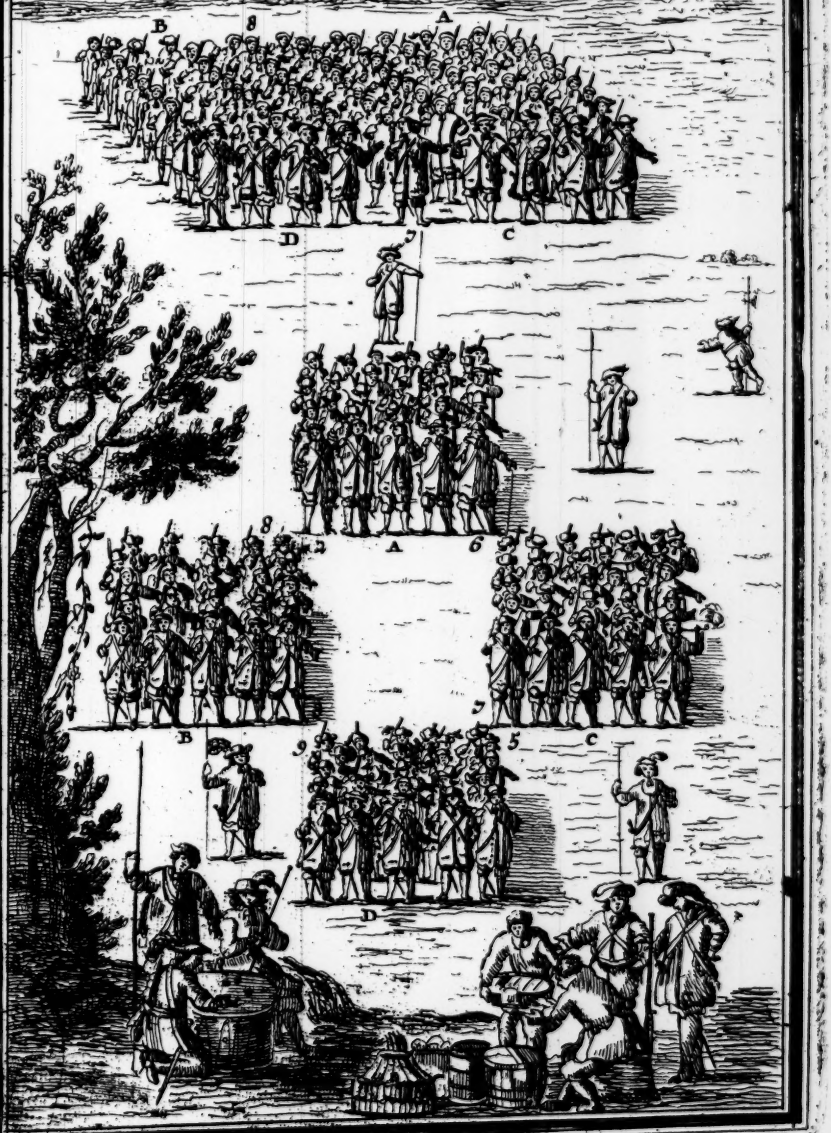


Plate. IIII
S. P.

Plate. V

S. P.



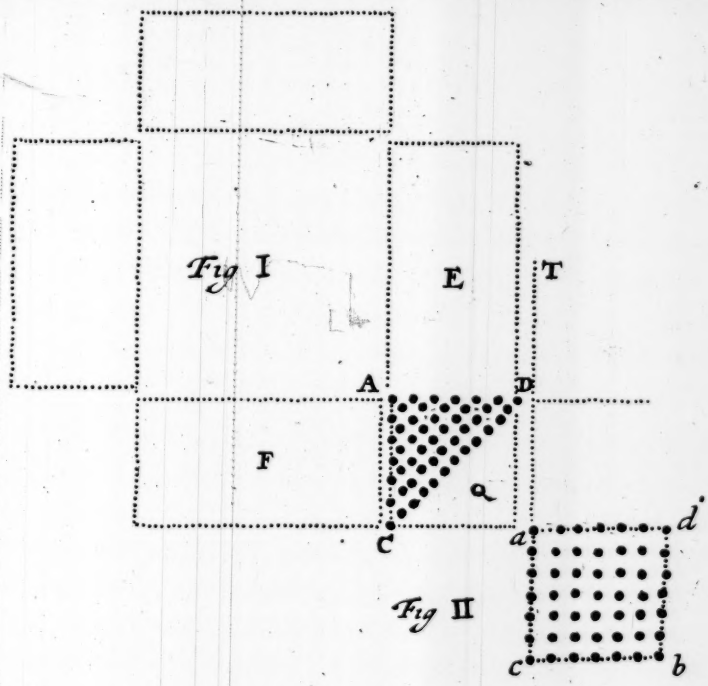


Fig I
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Fig II
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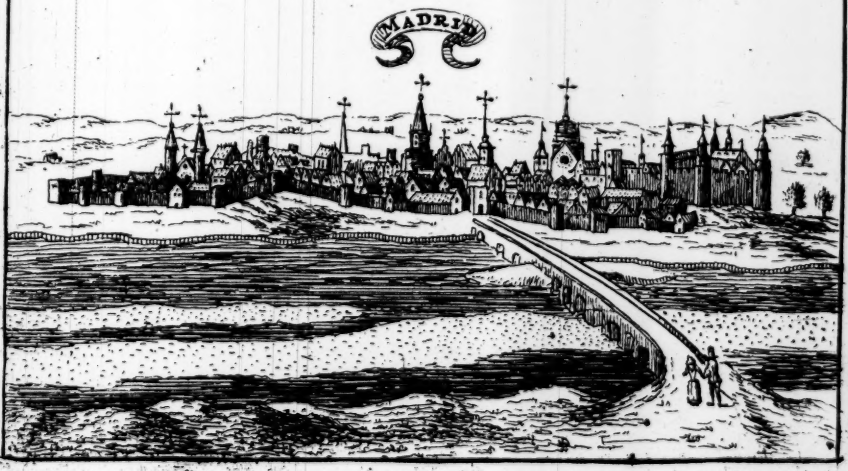
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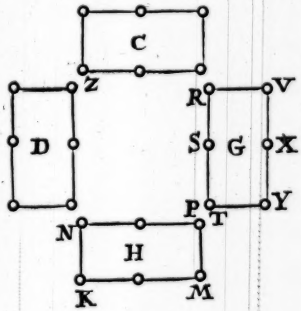

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Fig. I.

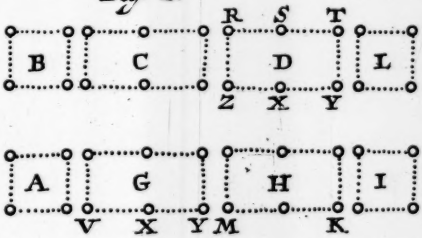

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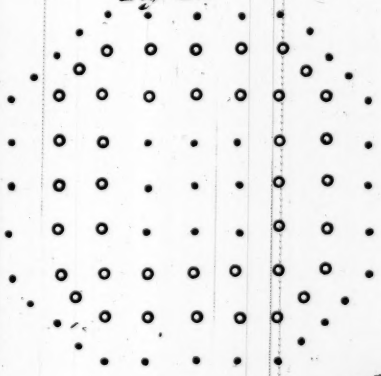
Fig. IV.



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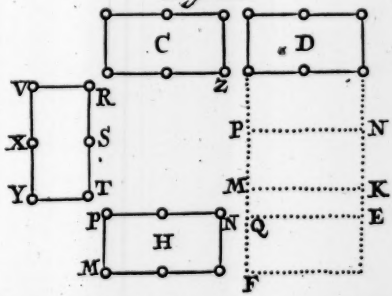
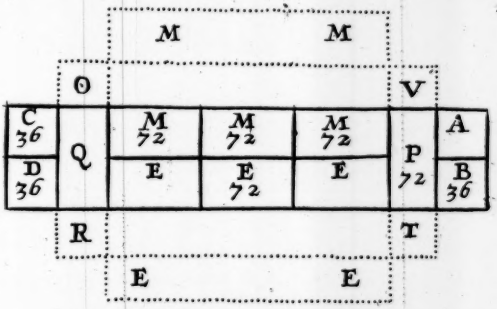


Fig: I.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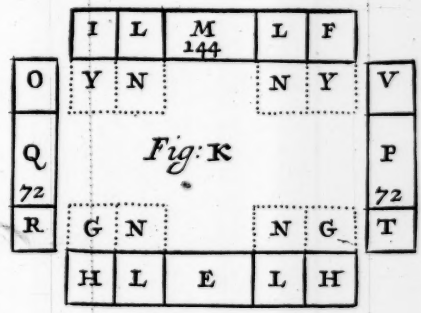
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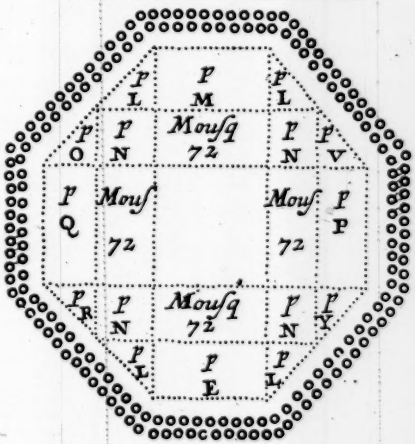
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Fig: 8

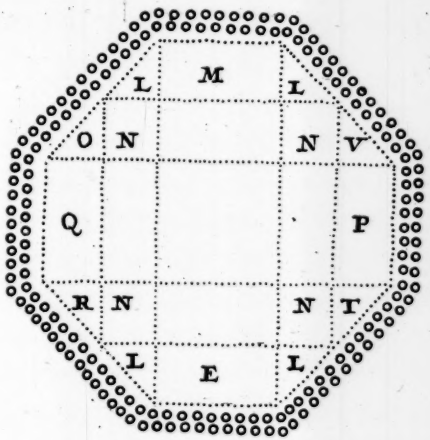
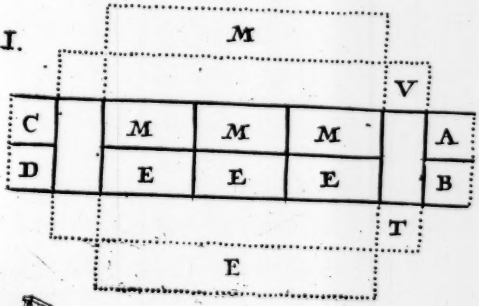


Fig. I.



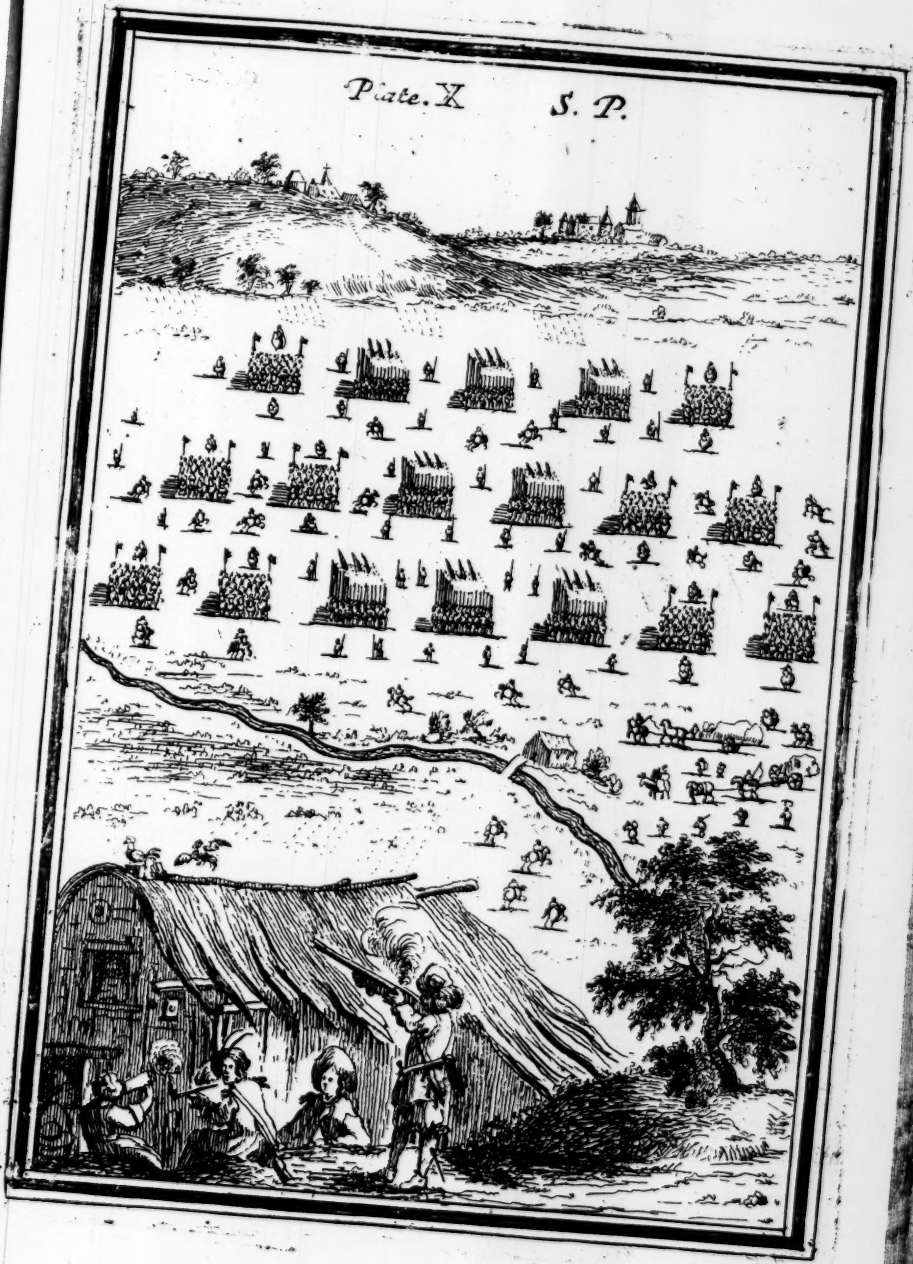


Plate. X
S. P.

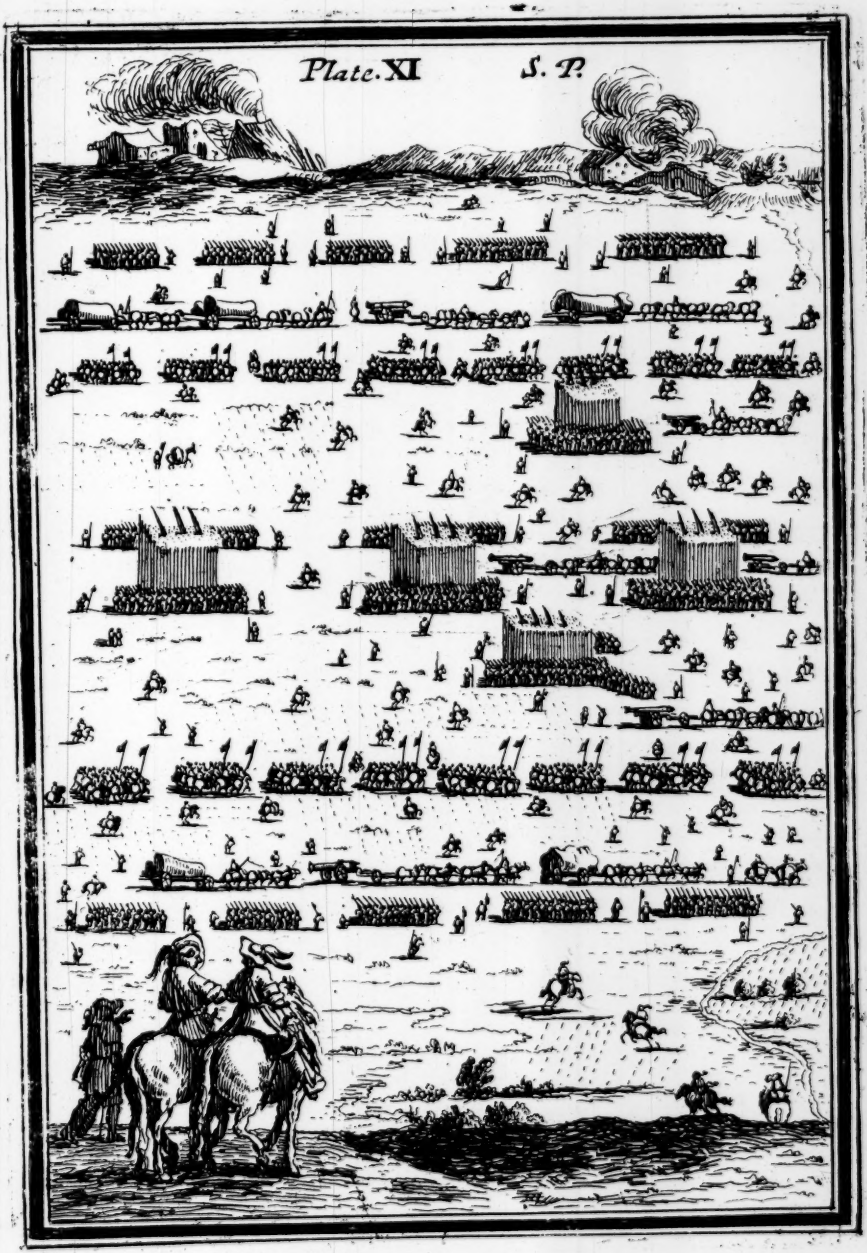


Plate. XI
S. P.

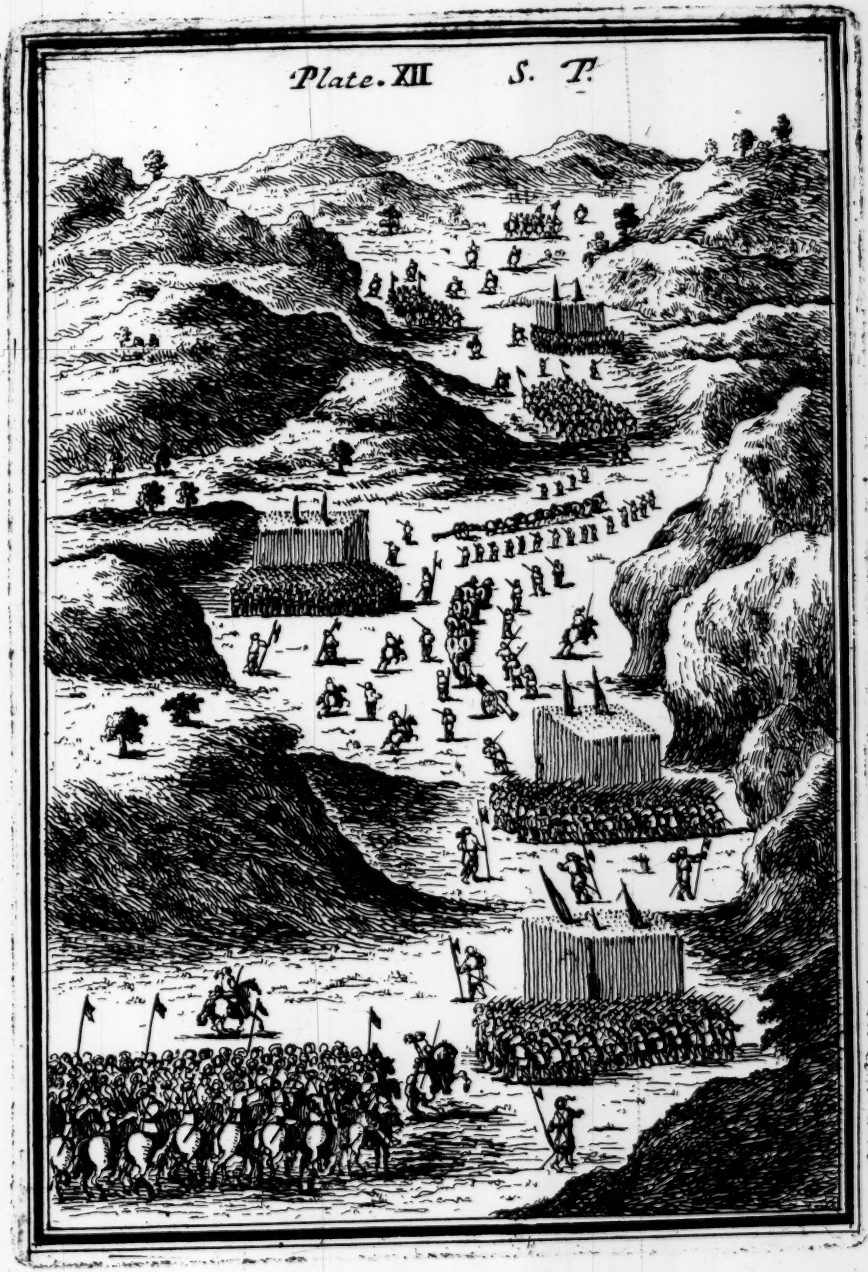
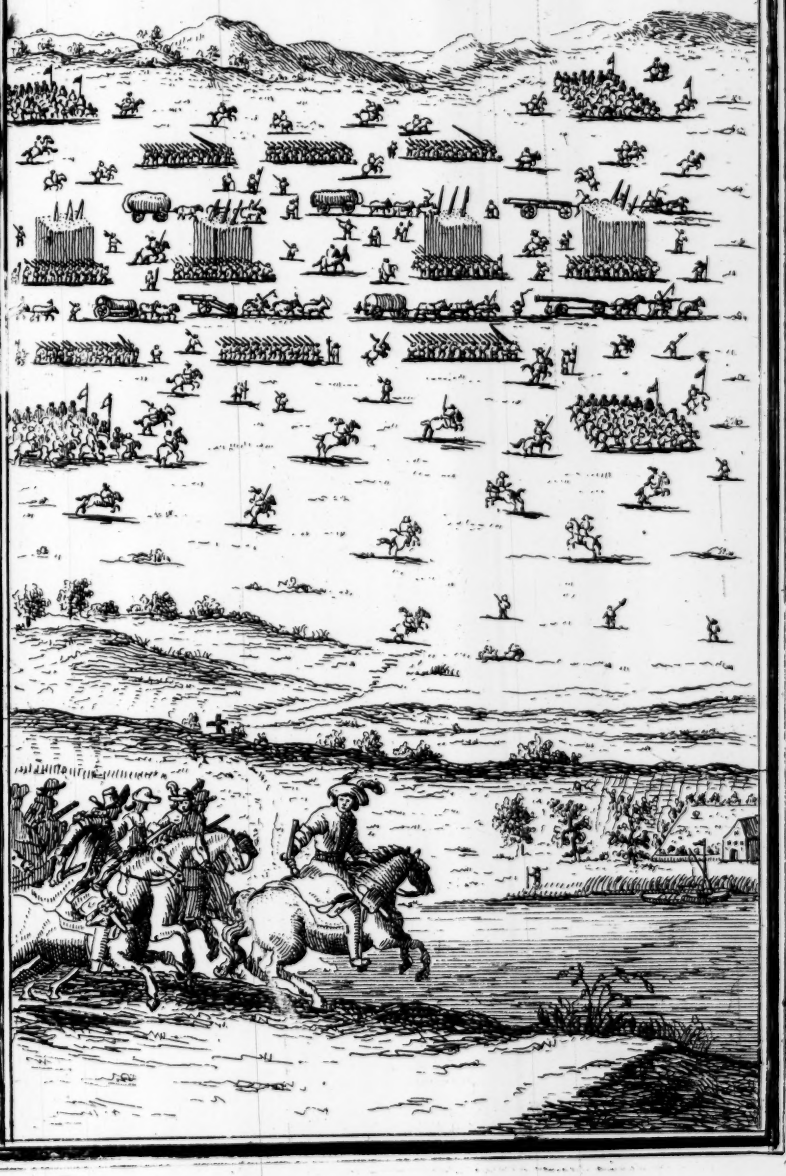


Plate. XII S. T.

Plate. XIII S. P.



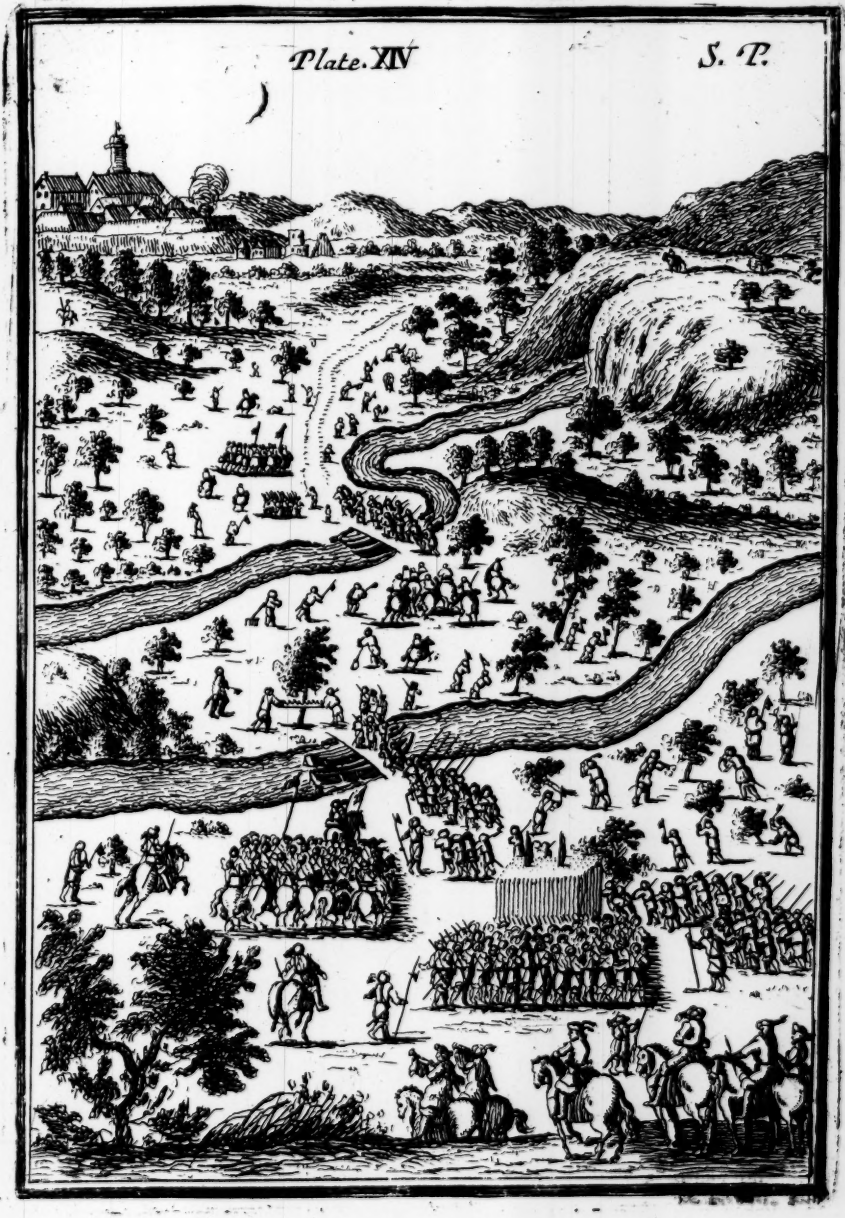
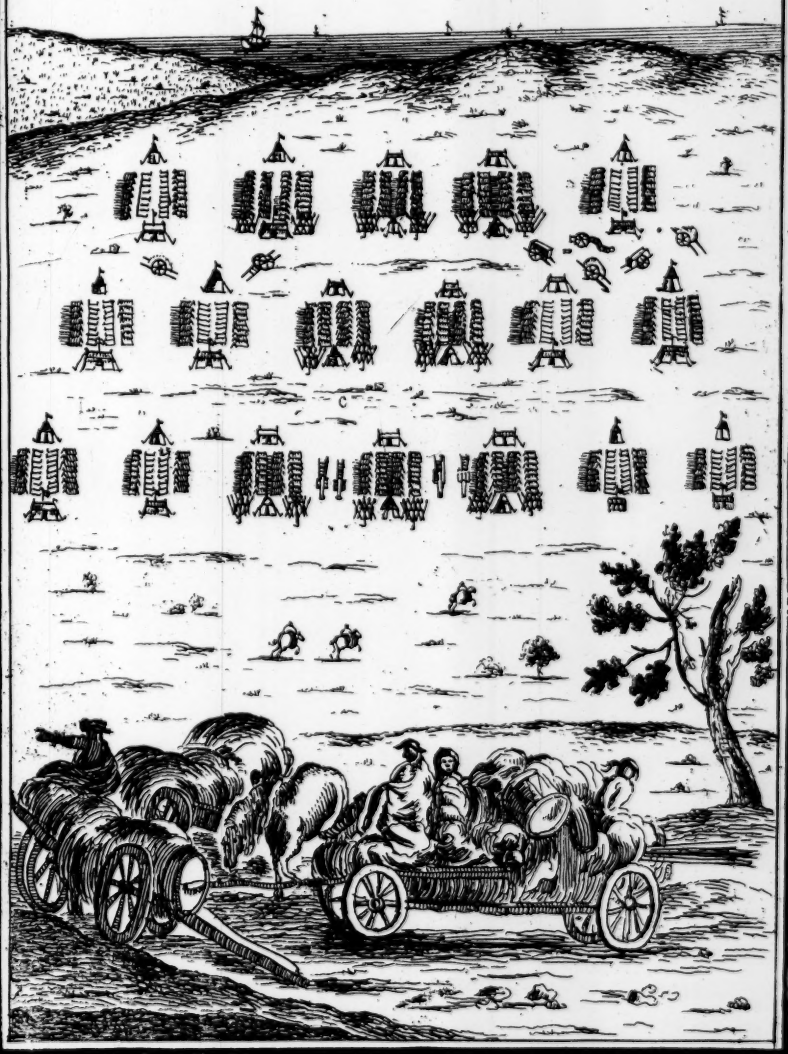
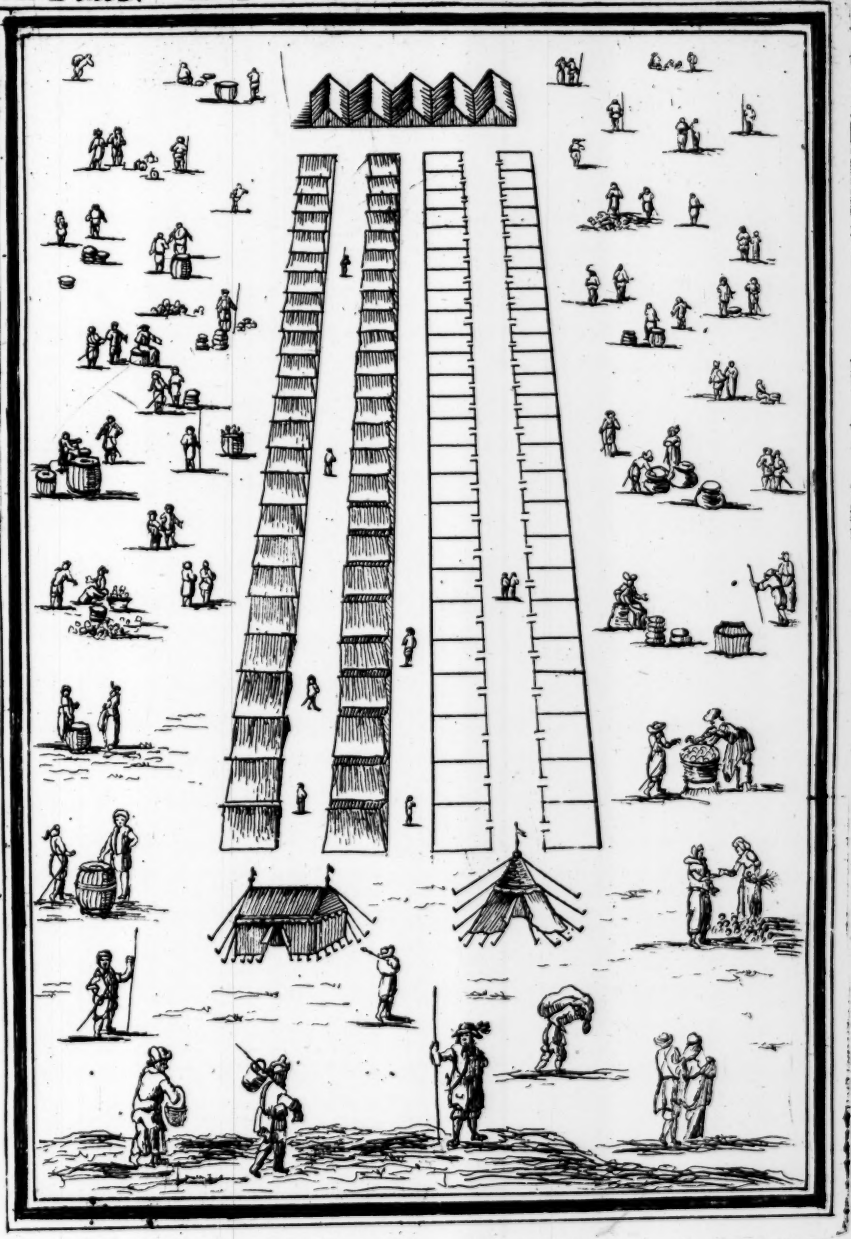


Plate. XIV
S. P.

Plate. XV *S. P.*





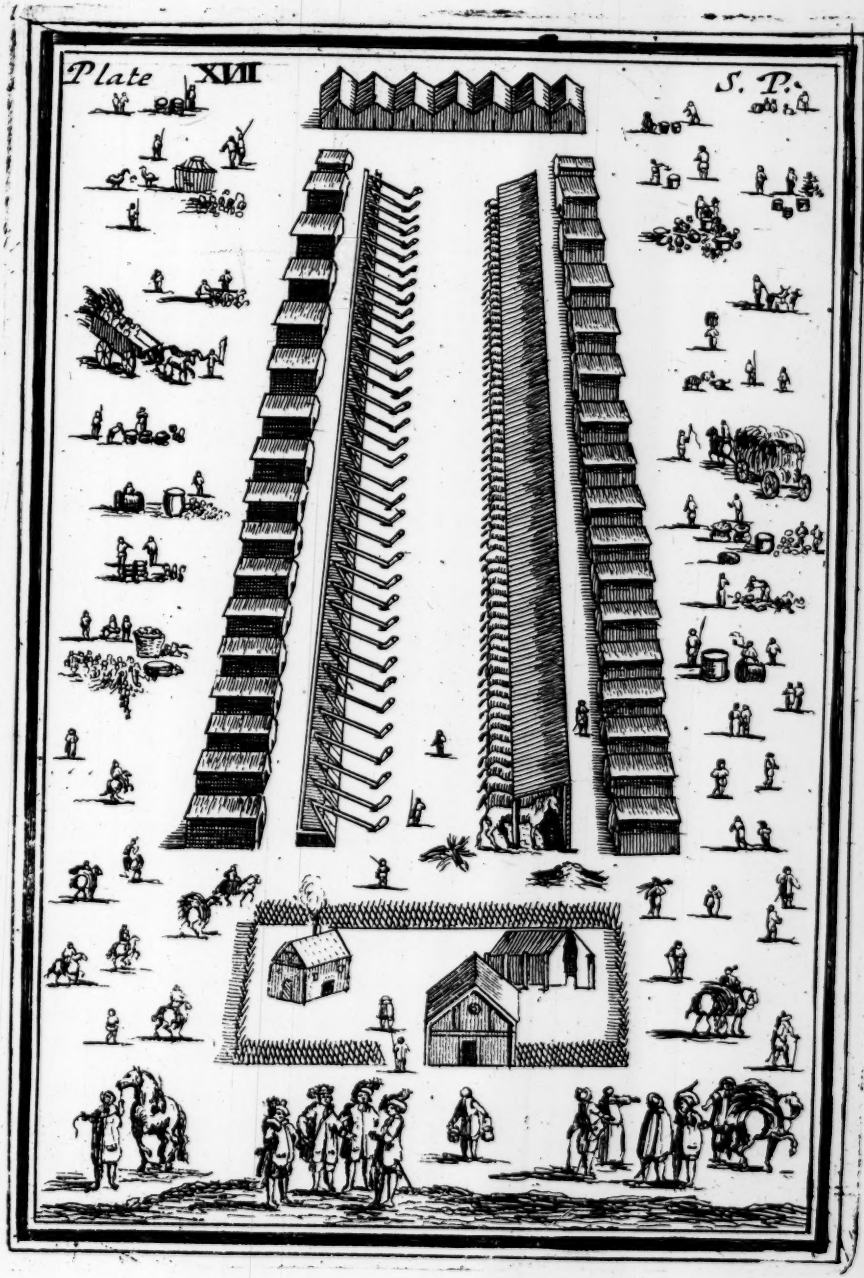


Plate XVII
S. P.

Plate. XVIII. S. P.

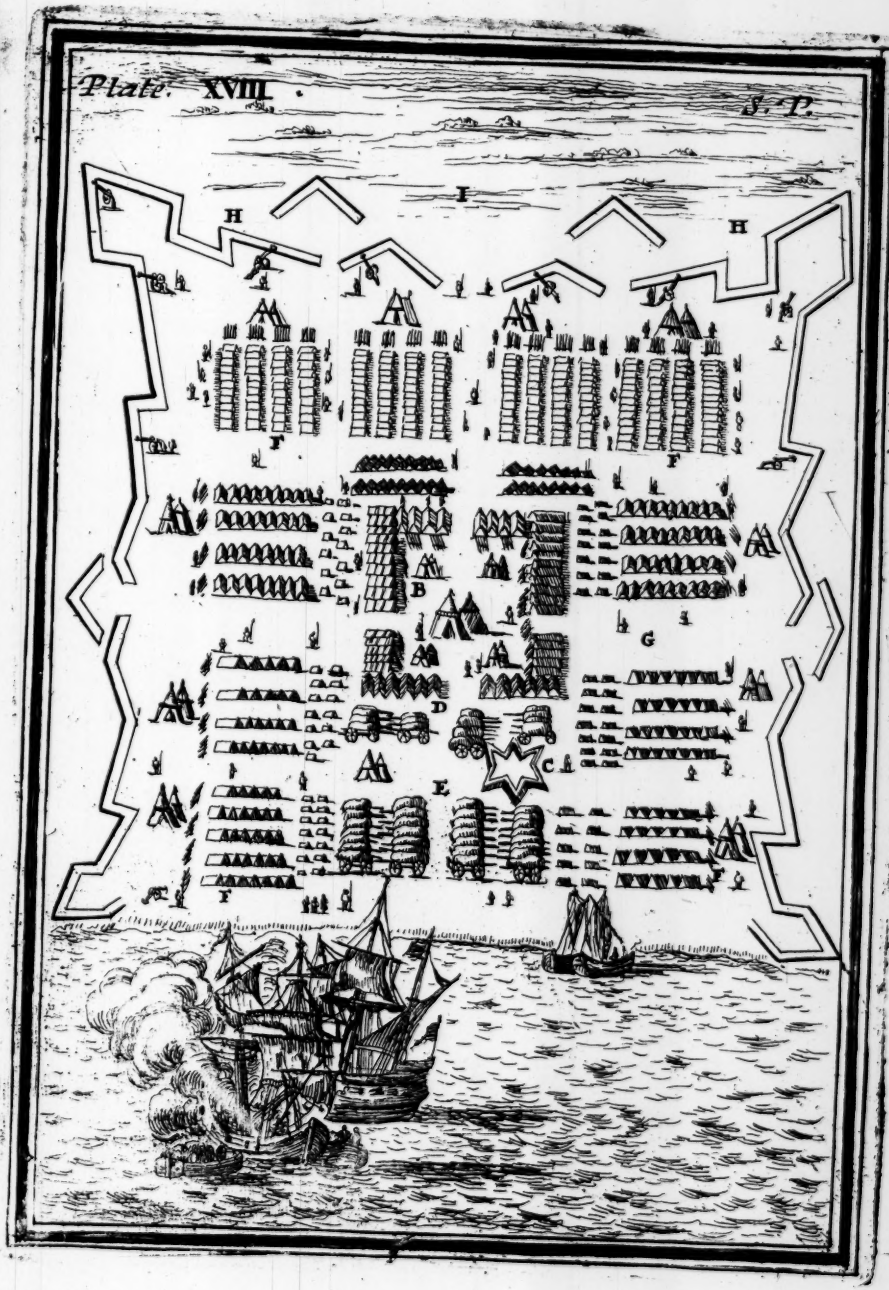


Plate. XVIIII. *S. P.*